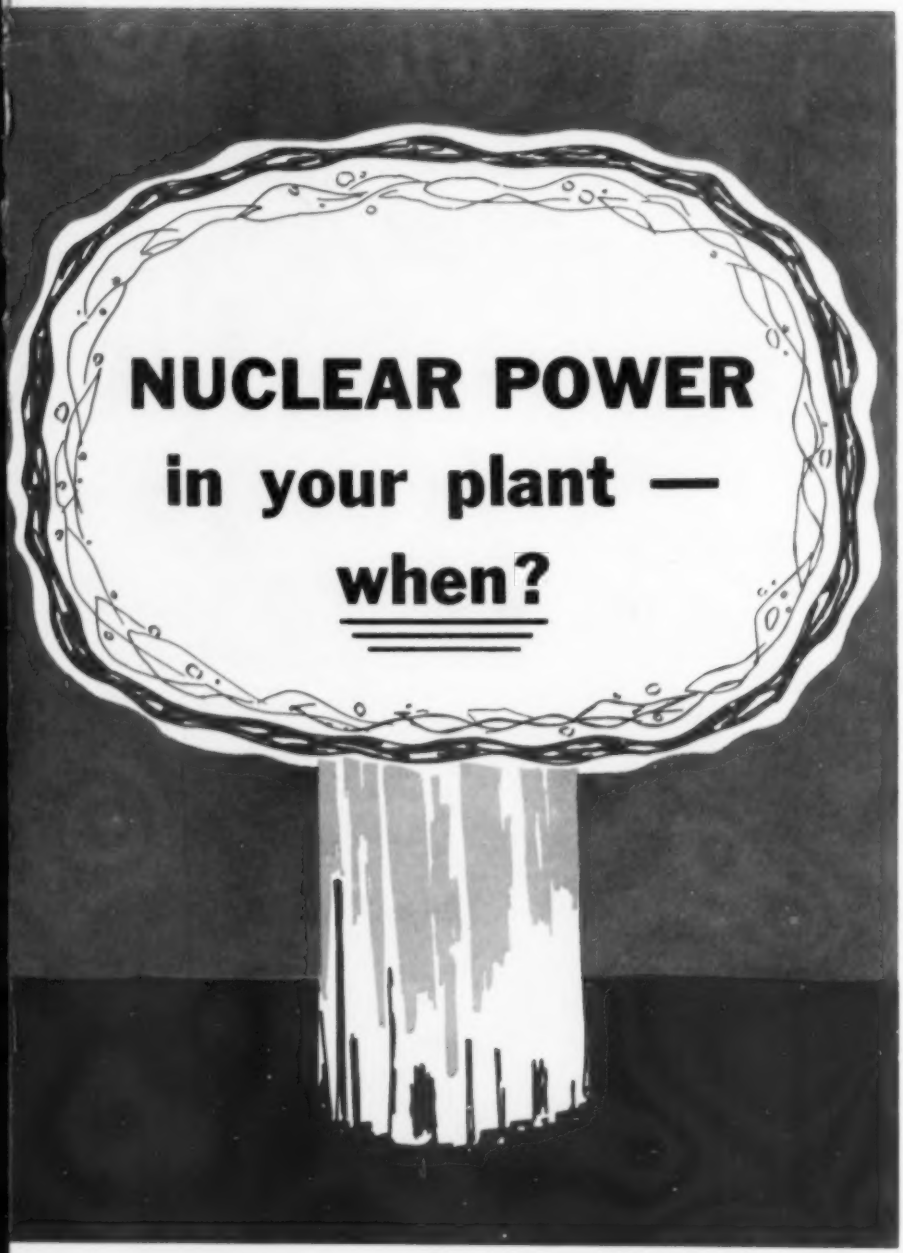
Industry and Power

September 1955



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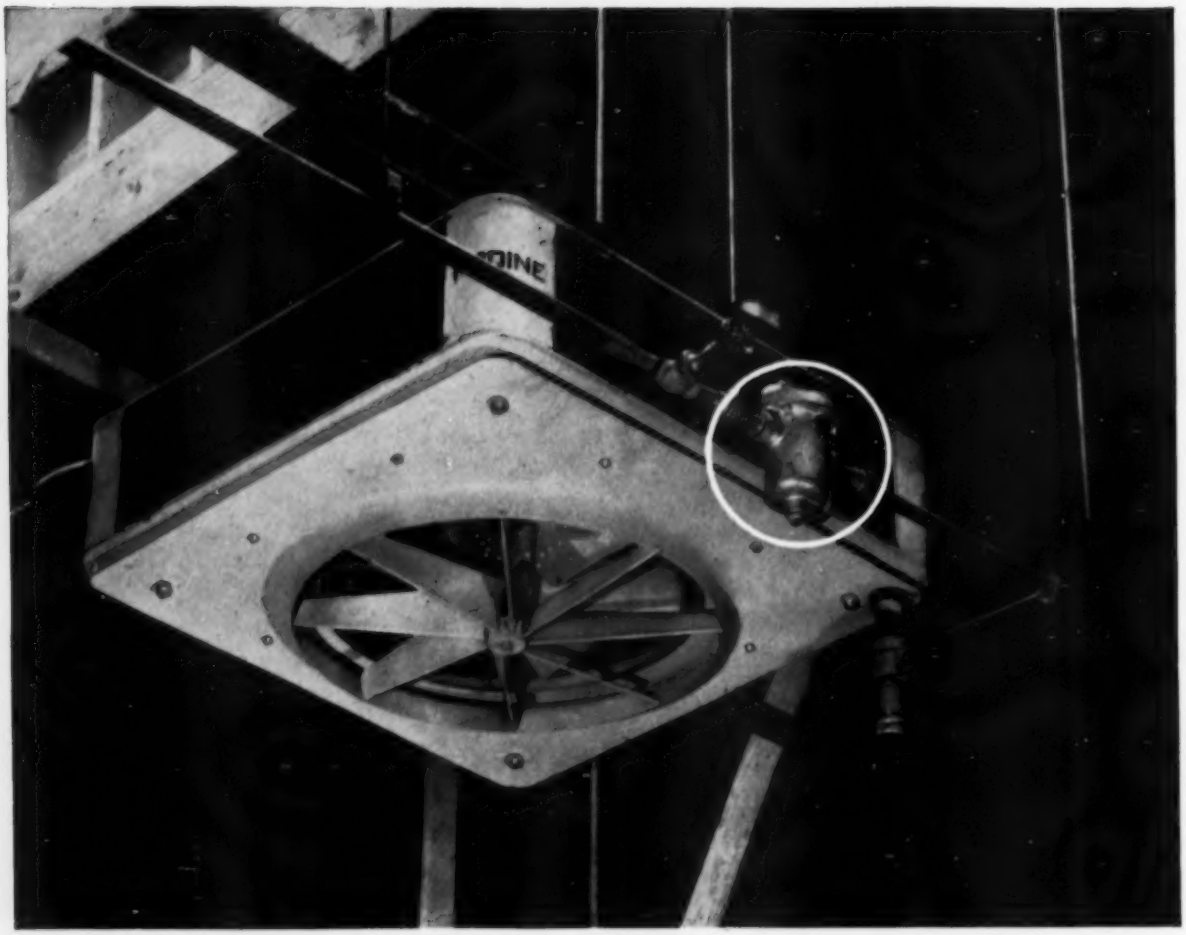
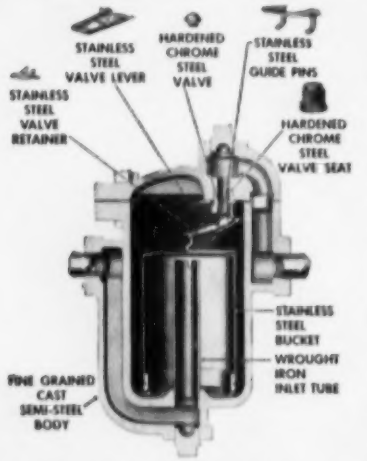


How Corrosion of Unit Heaters is Prevented by Good Trapping


STAINLESS STEEL VALVE LEVER
HARDENED CHROME STEEL VALVE
STAINLESS STEEL GUIDE PINS
STAINLESS STEEL VALVE RETAINER
HARDENED CHROME STEEL VALVE SEAT
STAINLESS STEEL BUCKET
WROUGHT IRON INLET TUBE
FINE GRAINED CAST SEMI-STEEL BODY

Good Traps. The mechanisms in Armstrong traps for unit heaters are substantially identical in design, workmanship and materials to those used in traps for 900 lbs. pressure, 900 degrees F.

Cause. Costly corrosion of unit heaters is frequently the result of sluggish condensate drainage and inadequate venting. Any carbon dioxide gas present in the steam supply will go into solution if the condensate is below steam temperature, forming corrosive carbonic acid. Presence of oxygen aggravates the corrosion.

Remedy. Armstrong traps prevent carbonic acid formation because they discharge condensate *at steam temperature* and vent CO_2 and air at the same time. There is never any accumulation of condensate and incondensible gases to cause trouble as can occur with traps that must wait for condensate to cool before they will open.

Trap Selection. It is important that the traps be correctly sized, with a generous safety factor to provide adequate air handling capacity. Armstrong sizing recommedations are thoroughly reliable, being based on actual performance of the traps under operating conditions rather than on theoretical considerations.

Complete Details. Ask for Armstrong Bulletin No. 2312 which tells how to select and install traps for any type of unit heater. For your free copy, call your local Armstrong Factory Representative, or write:

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ARMSTRONG STEAM TRAPS *Application Engineered*

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of "keeping things moving"

Money "goes down the drain" quickly when production slows or stops anywhere along the line. You can prevent production bottlenecks with *your own* "inside" telephone system!

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ORIGINATORS OF THE AUTOMATIC TELEPHONE

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this month's comment

. . . from industry & power

we count on you . . . .

We know a sharp, well-seasoned publisher who contends that the best editor's chair is an empty one. We agree. The best place for an editor is in the field, meeting his readers and sounding out his information sources. His publication is the arena where he matches the two.

Now, if our contact with you could be multiplied, our effectiveness in matching our source material to your needs could be multiplied as well. To this end, we have made it standard practice to screen *everything* you send us, whether you write to the Reader Service Department, to the Circulation Department, or, of course, to the Editorial Department. This we find of great value in developing an editorial program suited to your wants and needs.

Specifically, we watch the trends in your requests for tear sheets of the articles we run. We watch the trends in your requests for reprints of articles and Special Reports. We watch the trends in your requests for new equipment information and for manufacturers' bulletins. We watch your response to our advertisers' messages. All this we do in the *editorial* department because your collective reactions give us a measure of your pulse.

Even more important is the statistical information you give us on the forms our Circulation Department sends you. Circulation's needs are based on the industry-wide circulation auditing system to which we subscribe. But we in Editorial take the opportunity to ask a little more of you than the audit requires. And this extra data improves the picture we have of you and your plant.

Most important to us are the comments you volunteer on your cards and letters. They are most important to us because they are not buried in statistics. They are candid. They are conversational. They are, therefore, the best substitute for a personal call that we could have.

And so we come to the point from which we started: the best place for our editorial staff is in your plant. A major portion of our editors' travel program is taken up with calls on you in your plant. It is impossible, though, for our staff to get into the 30,000 plants INDUSTRY & POWER enters 12 times a year. We count heavily on your mail to help us find out more about you and your work. We count on you.

Harold A. Bergen, Editor

The John Paul Taylor Publishing Co.
Commercial Bank Building, St. Joseph, Michigan

Industry and Power

Volume 69 **September 1955** Number 3

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nuclear news

. . . . about industry & power

NUCLEAR POWER NEEDS MANPOWER

An AEC spokesman points out that there are some 5000 scientists and engineers currently working on atomic power problems. Only eight years ago, in 1947, there were probably not over 50 working on atomic power in this country. Significant as this increase in manpower assigned to nuclear power may look, Louis H. Roddis, Jr., deputy director of the AEC's Division of Reactor Development, believes "that by far the largest problem in atomic power today is that of technical manpower. . . . There appears to be no end in sight to the requirements in the technical manpower field."

WRAPS COME OFF AT GENEVA

Wraps came off of many significant developments at the International Conference on the Peaceful Uses of Atomic Energy held last month at Geneva, Switzerland. Some 1260 representatives and advisors came from 72 countries, along with 300 representatives of the press. . . . The United States revealed specific details about the reactor core to be used in the Shippingport, Pennsylvania plant being built by Westinghouse for Duquesne Light Company. The core will contain 12 tons of natural uranium in a blanket surrounding some 115 pounds of highly enriched uranium seed. . . . In another paper, Argonne National Laboratory gave details of a nuclear reactor that was made to "run away" to confirm the inherently safe characteristics of the reactor, even under the conditions of the planned "accident." . . . So it went at Geneva, the history-making interchange of knowledge about a reaction first achieved less than 15 years ago—punctuated by outspoken speculation that fission power will soon give way to fusion power.

MORE REACTOR PROJECTS GET UNDERWAY

Commonwealth Edison Company, Chicago, signed a contract with General Electric Company for a 180,000-kw boiling reactor plant to be built at a cost of $45,000,000. . . . The AEC has authorized negotiations for Detroit Edison Company and Associates on a fast breeder reactor, rated 100,000 kw, to be completed in late 1959. . . . Foster Wheeler Corporation is showing a 100,000 kw nuclear power reactor it can build as cheaply as a con-

Fewer Parts Mean Greater Dependability

Floorstand Motor Unit . . . control panel, motor, limit switch and push button station.

Simple, durable mechanism of Chapman's Motor Unit. Handwheel remains stationary during motor operation.

IN CHAPMAN MOTOR UNITS

Chapman's simple and rugged Motor Unit gives accurate, trouble-free control of large valves and sluice gates. It has approximately *half as many parts* as any other unit. Its simplified design, low speed motors and low-ratio, stubtooth gears combine to give positive operation without drift, in *any* position and under all conditions.

Installation is fast and simple. The floorstand unit comes completely wired, ready to connect to leads. Limit switch has micrometer adjustment for exact pre-setting for seating tightness. Motor Units operate smoothly under the most adverse conditions. All units are weather-proof and steam-tight. Write today for *new* Catalog 51.

The Chapman Valve Manufacturing Co.

INDIAN ORCHARD, MASSACHUSETTS

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MOGUL
"Kwik-Kleen"
SCALE REMOVER

The first truly safe and wholly effective method for rapid scale removal. Proven outstandingly successful wherever used.

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Will remove most stubborn scale deposits quickly and easily from:

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- *Evaporative Condensers*
- *Shell and tube Condensers*
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- *Heat exchangers*
- *Compressors*
- *Inter-coolers*
- *After-cooler*
- *Boilers*

Will not irritate or harm the hands and arms, so requires no gloves, goggles or face masks. Give off no harmful, corrosive fumes.

Mogul "Kwik-Kleen" comes in measured moisture proof bags, packed in drums. Dissolve in water — easy and ready to use.

Write today. Tell us about your scale problem.

The North American
MOGUL
PRODUCTS COMPANY
40 years of progress
... and still growing
CLEVELAND 13, OHIO

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nuclear news

. . . starts on page 6

ventional power plant for just $21,000,000. The aqueous homogeneous power breeder reactor can generate for as little as six to nine mills per kwh. . . . Combustion Engineering, Inc. has just received the green light for development of a reactor for small submarines. . . . Agreements between the AEC and two institutions of higher learning have been reached for the construction of research reactors. Pennsylvania State University and the University of California will each build a reactor under these agreements. . . . Pennsylvania Power & Light Company intends to build a privately financed homogeneous-type reactor power plant of at least 150,000-kw capacity with the expectation that the plant will be commercially competitive with stations using conventional fuels. The unit is expected to be ready to go on the line in 1962. . . . An industrial combine plans to build and operate the first nuclear reactor to be owned and operated by private industry for research in industrial and humanitarian fields. The reactor will be located in the New York area. The eight-firm combine consists of AMF Atomics, American Tobacco, Continental Can, Corning Glass Works, International Nickel, Chas. Pfizer, Socony Mobil Oil, and United States Rubber.

REPORT 42 REACTORS IN NUCLEAR CENSUS

The Atomic Industrial Forum reveals that an international survey they have just completed turned up 42 nuclear reactors. In addition, 20 reactors were found to be under construction and there are at least 48 reactors in the planning stages.

ON THE COMMERCIAL SIDE

Westinghouse just unveiled the world's first privately financed factory to produce parts for atomic power plants. The plant will make "canned" motor-pumps for radioactive fluids. . . . General Dynamics Corporation has formed a new general atomic division "as part of a new long-range program of basic scientific research, engineering development, and manufacturing in the nuclear field.". . . Union Carbide and Carbon Corporation has formed the Union Carbide Nuclear Company to integrate the parent firm's diverse activities in the atomic energy field.

BREECHINGS · STACKS

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Kirk & Blum has fabricated a variety of power plant needs as big as the mammoth breeching section shown here. In a 150,000 sq. ft. plant, with crane capacity to 25 tons, Kirk & Blum has complete facilities to produce, pre-assemble and load the largest fabrication. Kirk & Blum has the men, materials and experience to do the job quickly and economically.

For detailed literature, write: The Kirk & Blum Mfg. Co. 3174 Forrer St., Cincinnati 9, Ohio

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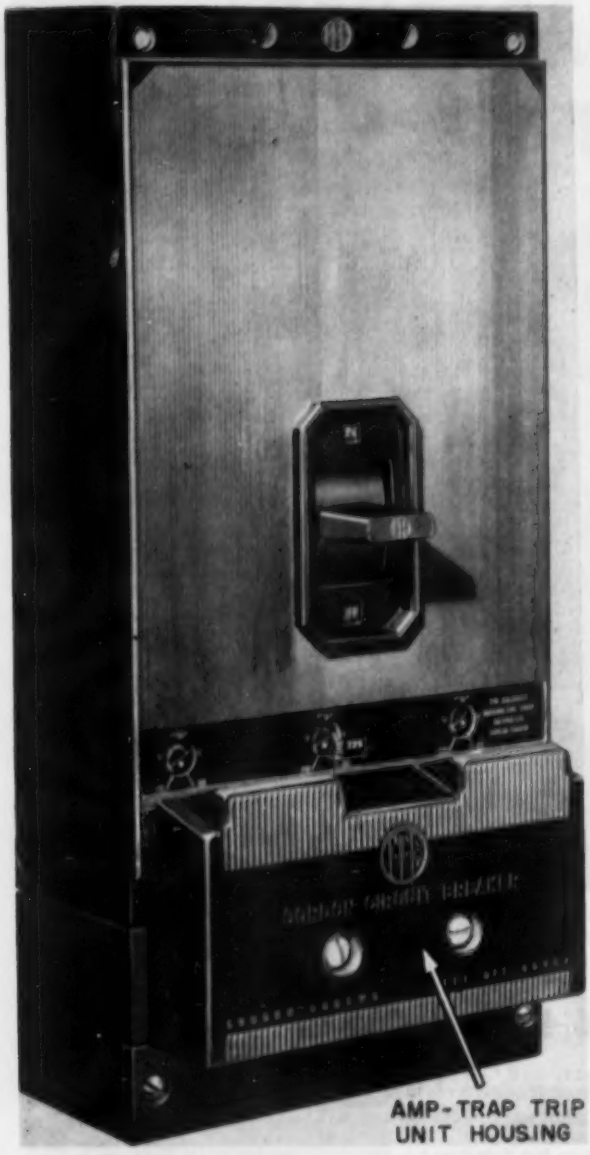
new equipment

. . . just circle key numbers on READ-N-CIRCLE card on page 83

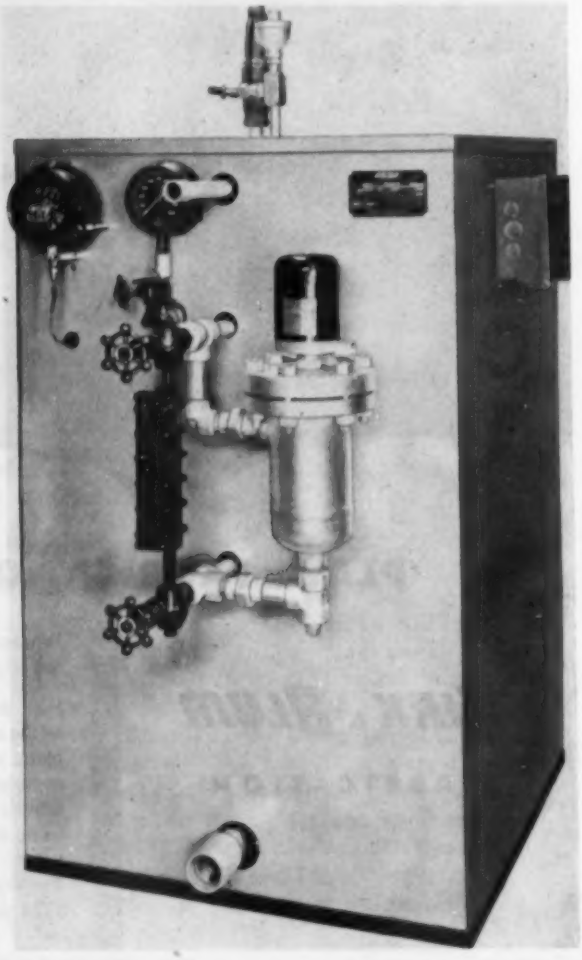


700-Circuit breaker teams up with current-limiting fuse

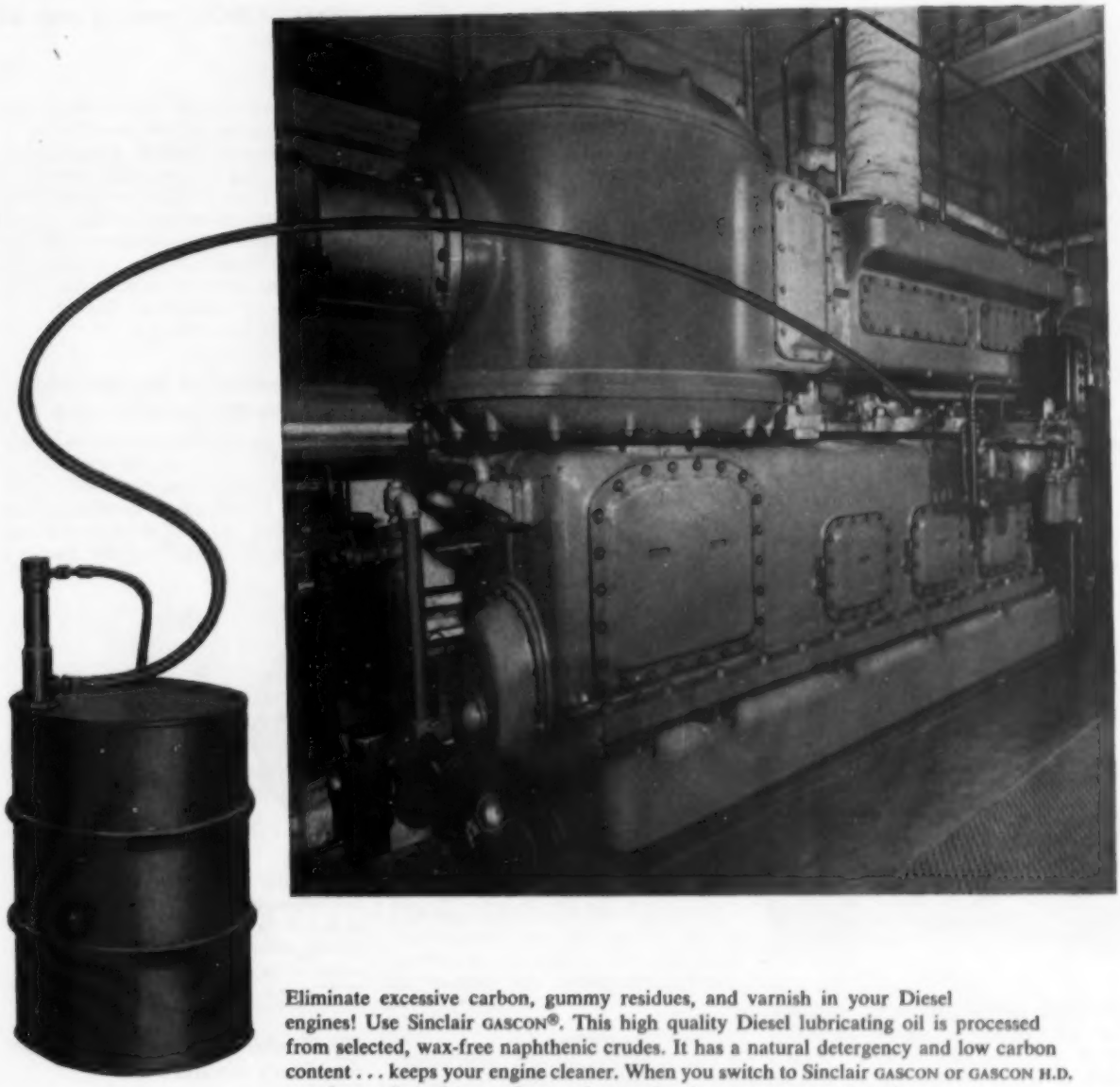
Compact electrical protector with short-circuit interrupting capacity of 100,000 rms ampers has all the advantages of a circuit breaker. Standard breaker section of the unit contains conventional thermal trip for minor overloads, and instantaneous magnetic trip for faults below extreme short-circuit currents. Current-limiting fuses clear faults at 80 percent of the interrupting rating of the breaker section (at 20,000 amperes in a 25,000-ampere circuit breaker). Short-circuit currents are completely interrupted in a quarter cycle, which allows the molded-case breaker to operate safely against the shock of a heavy fault. Mechanical linkage makes it impossible to damage equipment by operating on two phases when third phase faults to ground. Available up to 480 volts, three-phase, a-c or 250 volts d-c in four frame sizes with continuous current ratings of 100, 225, 400, and 600 amperes. I-T-E Circuit Breaker Co.

701-Electric package steam generators boast 98½% efficiency

New, self-contained steam generators operate on the electrode principle of generating steam electrically. They have full Underwriters' Laboratories' listing in sizes from 1½ to 15 hp. They can be used wherever precise control



Check Carbon!



Eliminate excessive carbon, gummy residues, and varnish in your Diesel engines! Use Sinclair GASCON®. This high quality Diesel lubricating oil is processed from selected, wax-free naphthenic crudes. It has a natural detergency and low carbon content . . . keeps your engine cleaner. When you switch to Sinclair GASCON or GASCON H.D. you know that pistons, rings, valves and exhaust ports stay free from carbon, gums and varnish.

No matter what design of engine you're operating, you'll be 'way ahead with Sinclair's complete line of Diesel lubricants. Contact your local Sinclair Representative now for full details, or write Sinclair Refining Company, Technical Service Division, 600 Fifth Avenue, New York 20, N. Y.

SINCLAIR GASCON OILS

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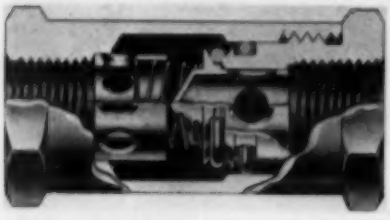
new equipment

. . . just circle key numbers on READ-N-CIRCLE card on page 83

of high-pressure steam is desired, in explosive atmospheres, or as supplementary steam sources in remote manufacturing areas. Steam is generated by a simple, economical method without heating elements. Low-water damage is impossible. Maximum economy is achieved by the compensating action of the water level in the boiler. This keeps electric input in precise balance with steam output. Available in sizes from 1½ to 60 hp, 15 to 500 psi, for use with 220-, 440-, or 550-volt power supply. Absence of stacks or flues simplifies installation. Units can be installed right next to process equipment. PANTEX MANUFACTURING CORPORATION.

702-Check valve for 3000 psi is chatter-free

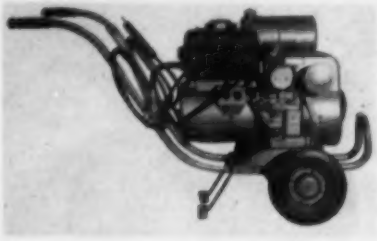
Dead-tight sealing and chatter-free operation of this rugged check valve result from use of a resilient O-ring as the sealing member. Location of the seal confines pressure to the



strongest part of the body. Suitable for vacuum and low-pressure pneumatic or hydraulic circuits. Available in brass, aluminum, steel, and stainless steel in sizes from ⅛- to 2-inch pipe size. JAMES-POND-CLARK.

703-Portable generator-welder splits for versatility

Portable low-cost a-c generator-welder combination that weighs 250 pounds is available on a two-wheel dolly or welded tubular steel carrying frame. The unit combines an air-cooled, 2500-watt, 115-volt, 60-cps, a-c electric generating plant with a 150-ampere transformer-type welder. The unit provides dependable electric power for on-the-spot maintenance welding. As separate units, the generator or welder may be operated independently of the other. If the welder is disconnected, the generator becomes a portable a-c power plant, and the welder can still be op-



erated by plugging into any 110- or 220-volt, single-phase a-c outlet. Unit is manually started with a pull rope. Recoil starter is optional. ROYAL ARC INDUSTRIES, INC. AND D. W. ONAN & SONS, INC.

FREE INFORMATION

For detailed free information on these products just circle the key numbers on the READ-N-CIRCLE card on page 83.

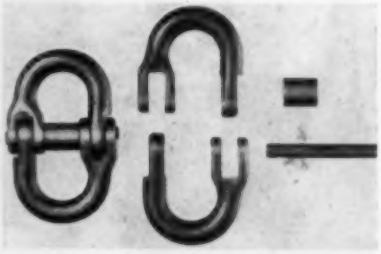
704-Lightweight pipe-fitting tools

Complete pipe-threading unit with folding tripod legs that weighs only 75 pounds can be used for all cutting, reaming, threading, and pipe-fitting

operations. Chuck takes only a few seconds to set up, handles ¼- to 2-inch pipe and conduit. Chuck grips, tightens, and centers pipe automatically in forward or reverse. Unit screws fittings on tighter than is possible by hand. Power is provided by variable-speed 115-volt, reversible, air-cooled, a-c or d-c motor with ball-bearing mounting. TOLEDO PIPE THREADING MACHINE CO.

705-Coupling link for alloy-chain attachments assembles fast

Coupling link that consists of a pair of body halves, a tubular stud, and a hardened alloy steel pin, can be assembled in seconds. It enables alloy chain users to make their own slings and special assemblies. No peening

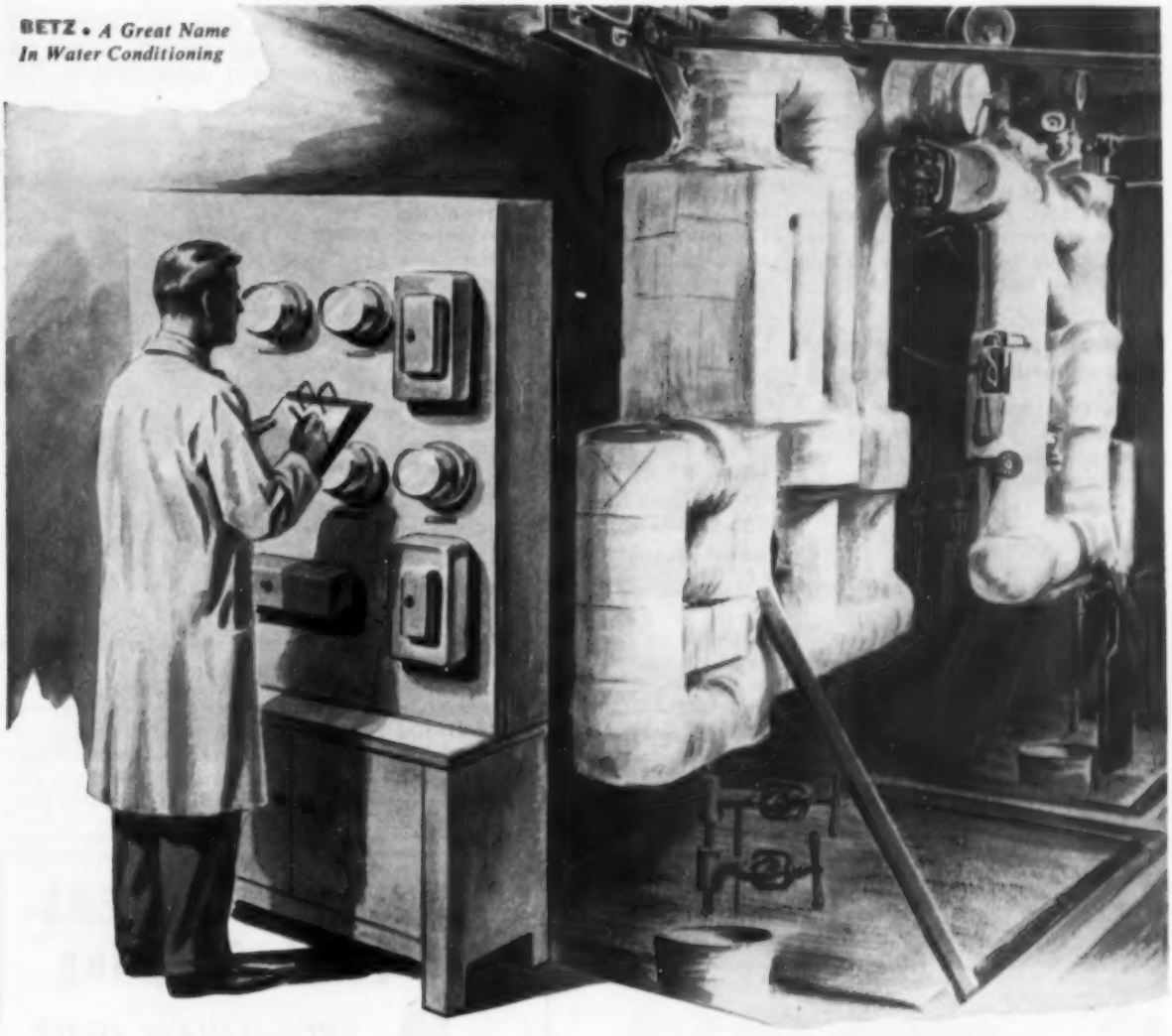


or welding is required. The link can be disassembled and reused. Constructed to withstand severe usage, link is stronger than alloy chain for which it is recommended. COLUMBUS MCKINNON CHAIN CORPORATION.

706-Combination burners need no secondary auxiliary air

Available for oil, gas, or combination gas-oil firing, these burners function against positive pressure without loss of capacity. Special modifications are available for firing against positive firebox pressures up to ¾ inch WG. Other features include a flame-stabilizing combustion head, a large fan and motor (providing ratings to 2,500,000 Btu input without secondary auxiliary air) and fully automatic operation. Controls, wiring, and all fuel valve piping are integrally mounted. New ignition system eliminates nozzle coking and plugging. Conventional gas pilot has been elim-

BETZ • *A Great Name In Water Conditioning*



Proving ground for an idea

Many of today's industry-accepted water conditioning techniques were unknown just a few short years ago. Yet they were made possible by the extensive research which is carried on daily at our headquarter laboratories in Philadelphia.

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BETZ

CONSULTANTS ON INDUSTRIAL WATER PROBLEMS

Circle 147 on READ-N-CIRCLE card for more data

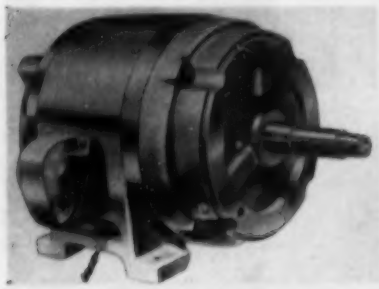
new equipment

. . . starts on page 10

inated. Main gas flame is ignited from a momentary oil firing cycle that results in a nozzle purge on each firing cycle. RAY OIL BURNER CO.

707-More compact close-coupled pump motor insures alignment

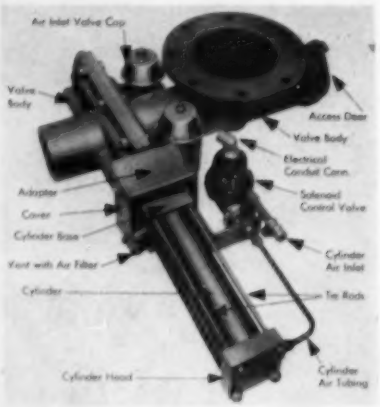
Face-type registered bracket and special shaft make this new motor suitable for close-coupled centrifugal pump applications. Built to the new



rerated NEMA specifications, the Uniclosed motor is extemely compact. Pump may be mounted flush with motor by bolting to face bracket, insuring accurate alignment. Solid flange and brass slinger are incorporated to prevent water from entering motor. Windings are asbestos-protected. Ball bearings are lubricated by Lubriflush system. Available in ratings from 1 to 30 hp. U. S. ELECTRICAL MOTORS, INC.

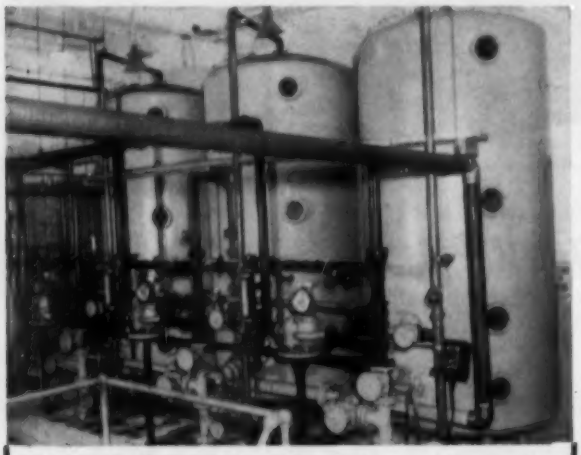
708-Self-feeding fly-ash valves avoid plugging up

Self-feeding valves with positive shutoff for flow control of fine solid materials in pneumatic systems are available with either air-electric, remote, or manual controls. Sliding shutoff gates give better protection against leakage than conventional types because the vacuum removes material that could cause clogging and holds the gate tightly seated. Valves with four-inch diameter outlets are suitable for four- through six-inch transport piping systems. Particularly suitable for handling such materials as boiler fly ash and industrial dusts. ALLEN-SHERMAN-HOFF CO.



709-Rapid scale remover reaches inaccessible spots

Granular powder not only removes scale much quicker than conventional mechanical methods, but is so safe that it can be handled without protective clothing. Comes in pre-



18,000 GPH H&T UN-A-BED DEMINERALIZER PLANT

. . . a typical H&T installation

Since 1943, we've been building demineralizer plants. All sizes, all capacities — manual or automatic available. Highest quality, attractive prices, fully guaranteed. Hundreds of units in service.

Also a complete line of other water conditioning systems.

Write for details.

HUNGERFORD & TERRY, INC.

CLAYTON 7, NEW JERSEY

Circle 149 on READ-N-CIRCLE card

RONNINGEN FILTERS are Quick Coupling

OFF-CLEAN-ON AGAIN in 60 seconds:

NO TOOLS

STOPS NOZZLE PLUGGING

QUICK DISCONNECT OUTLET AND INLET

REMOVES IRON

For white water, raw river water, well water. 5 to 800 GPM. Pressures to 200 PSI.

Filter is sealed at both ends. No dirt can sneak around the ends.

Write for free bulletin 25406P

STRAIN AGAIN with RONNINGEN

"Particles large or small, we FILTER them all"

RONNINGEN MFG. CO.

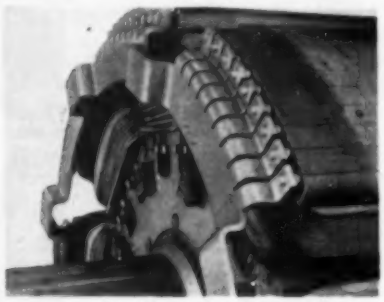
Vicksburg, Michigan Phone 5161

Circle 141 on READ-N-CIRCLE card

weighed, moisture-proof bags. Product is noncorrosive. Descaled metal is left bright without any sign of etching. Removes even the most stubborn deposits in double-quick time from heat exchange equipment. NORTH AMERICAN MOGUL PRODUCTS COMPANY.

710-Flexible fingers foil failures on large motors

New cage winding for large synchronous motors with severe starting requirements (such as those driving high-inertia, high pull-in torque loads) makes several starts a day possible. Damper bars are brazed to a new-type end ring that has three-



way give against expansion, and high heat-dissipating capacity. This feature eliminates heavy stresses on the damper bars even with slow or repetitive starts, and removes the tendency for bars to burn out. ELECTRIC MACHINERY MFG. COMPANY.

FREE INFORMATION

For detailed free information on these products just circle the key numbers on the READ-N-CIRCLE card on page 83.

711-Gate valve has renewable seat ring for in-line repairs

Renewable-seat-ring gate valve permits replacement of its seat ring in only 7 to 10 minutes under all con-

Your plant and equipment suffers . . . your community goodwill fades away. These problems can be solved. Prat-Daniel Collectors are designed for the control of industrial dusts and flyash. Multiple small diameter tubes provide powerful centrifugal forces, resulting in sustained high collection efficiency . . . even with ultra-fine dusts.

Whether the problem is industrial dust or flyash, you are assured of satisfaction with P-D Collector Systems, engineered to meet your specific needs.

Write for Reprint No. 102 titled, "What Type Collector?"

pd

Project Engineers
THE THERMIX CORPORATION
GREENWICH, CONN.
(Offices in 38 Principal Cities)
Canadian Affiliates: T. C. CHOWN, LTD., Montreal 25, Que.

Designers and Manufacturers
PRAT-DANIEL CORPORATION
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POWER DIVISION: Tubular Dust Collectors, Forced Draft Fans, Air Preheaters, Induced Draft Fans, Fan Stacks
Circle 100 on READ-N-CIRCLE card

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SOLAR GLARE AND HEAT IN YOUR PLANT PERMANENTLY INEXPENSIVELY

CRYSTAL FROST your glass walls and skylights

CRYSTAL FROST transforms glaring, hot glass surfaces into cool, heat deflecting, light diffusing structures.

CRYSTAL FROST PROVIDES

Lower plant temperature
Shadowless diffused light
Comfort to employees
Improved appearance of buildings

CRYSTAL FROST ELIMINATES

Sun glare
Almost all outside window washing
Installation of expensive special glass'
Painting of glass
Cracked glass due to painting

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Kwh of illuminating energy
Its own cost in a year
Cost of recurrent painting

Drop coupon in mail or use reader's service card for cost details and information.

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☐ **Have representative call**
☐ **Tell us about Crystal Frost**

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Your Title .....
Company .....
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City..... **Zone**....
State .....

Circle 155 on READ-N-CIRCLE card

new equipment

. . . starts on page 10

ditions with the valve body still in the line. Only a screwdriver is required. Valve is suitable for severe service on 200-psi steam, 400-psi water, oil, or gas lines. Available in ½- through 2-inch sizes. Monel seat ring and nickel-alloy wedge make the union bonnet valve corrosion resistant. THE FAIRBANKS COMPANY.

712-Torque reducer makes closing large valves effortless

Planetary-gear torque reducer permits "one-man" operation of 10-, 12-, and 14-inch Saunders Diaphragm Valves. Torque reducer provides a 5:1 mechanical advantage, and is

available on either handwheel or chain-operated valves. Available for new valves or those already in service. Assembly is mounted atop the bonnet and increases overall height by only 7½ inches. HILLS-MCCANNA CO.

713-Electric cable hoist is compact

Fully enclosed electric cable hoist with a lifting speed of 25 fpm features unusually close headroom. Gears and bearings are permanently lubricated. Pushbutton controlled with 110 volts at the control box. Load protection is provided by a solenoid-operated motor brake and heavy-duty Weston-type friction brake. Available in ¼-

and ½-ton models that operate on 110/220-volt, single-phase, or 220/440-volt three-phase, 60-cps current. One-ton model uses 220/440-volt, three-phase, 60-cps current. DAVID ROUND & SONS, INC.

FREE INFORMATION

For detailed free information on these products just circle the key numbers on the READ-N-CIRCLE card on page 83.

714-Visual tachometer measures speed from a distance

Lightweight visual tachometer measures rotary or vibratory speeds of machinery or objects from a distance of 3 to 50 feet. Operates by a

spring-wound mechanism that stops motion by stroboscopic principle. Weighs only 11 ounces. Made in two basic ranges: 500 to 8000, and 1000 to 16,000 rpm-vpm. Accurate to within

(more new equipment on page 88)

Air Casualties

It's bad air that does it. But you can step up production by putting a Coppus Blower on the job to keep the air moving — and keep the men cool.

The kind of air a man works in has a lot to do with how much work he can turn out.

In confined places like shipholds or tanks or drums or boilers . . . or wherever the air is stagnant or hot or full of fumes . . . a Coppus Blower is a *must* for getting first-class work out of the men, all the time.

A Coppus Blower or Exhauster helps avoid sickness and lassitude due to bad air . . . and improves morale, too.

Portable and adaptable for special purposes, Coppus Blowers and Exhausters will have dozens of uses around your plant. The "Blue Ribbon" (a blue painted band) is your assurance of quality performance at lowest cost.

COPPUS

BLUE RIBBON BLOWERS

CABLE MANHOLE AND TANK VENTILATORS — BOILER MANHOLE BLOWERS AND EXHAUSTERS — HEAT KILLERS — SHIPHOLD VENTILATORS . . . DESIGNED FOR YOUR INDUSTRY — ENGINEERED FOR YOU

MAIL THIS COUPON To Coppus Engineering Corp., 189 Park Avenue, Worcester 2, Mass. Sales offices in THOMAS' REGISTER. Other "Blue Ribbon" Products in BEST'S SAFETY DIRECTORY.

PLEASE SEND ME INFORMATION ON SUPPLYING FRESH AIR TO MEN WORKING:

- ☐ in tanks, tank cars, drums, etc.
- ☐ in underground cable manholes.
- ☐ in aeroplane fuselages, wings, etc.
- ☐ on coke ovens.
- ☐ on steam-heated rubber processes.
- ☐ on boiler repair jobs.

COOLING:

- ☐ motors, generators, switchboards.
- ☐ wires and sheets.
- ☐ general man cooling.
- ☐ around cracking stills.
- ☐ exhausting welding fumes.
- ☐ stirring up stagnant air wherever men are working or material is drying.
- ☐ drying of walls, sheets, etc., after treated with coating material.

NAME .....

COMPANY .....

ADDRESS .....

CITY .....

(Write here any special ventilating problem you may have.)

Circle 102 on READ-N-CIRCLE card for more data

new bulletins

. . . just circle key numbers on READ-N-CIRCLE card on page 83

400-Friction loss chart

Friction loss chart for flexible hose is offered in Bulletin 41-44 along with application and technical data. Accessories, installation data, and price lists are included. Eighteen pages. THE FLEXAUST COMPANY.

401-Useful facts on fire fighting

Engineering data and useful facts on Foamite Airfoam fire protection systems, portable and semi-portable equipment, are well illustrated in Bulletin AD 17004-10M. Information to help combat various types of flammable liquid fires is included. Thirty-six pages. AMERICAN LA-FRANCE CORPORATION.

402-Propeller fan performance data

Bypass duct fan and a double-ring reversible fan are described in Catalog A-109A. Specifications, dimensions, and performance data figures on 18 other types of industrial ventilating fans, intake units, unit heaters, and accessories are also included. Forty pages. HARTZELL PROPELLER FAN COMPANY.

403-Refractory properties tabulated

Entire range of products and typical applications of each are covered in Bulletin 67. P.C.E. temperature service range, storage properties, setting characteristics, and other data are tabulated for quick reference. Four pages. PLIBRICO COMPANY.

404-Moisture vapor content chart

Evaluation of the water vapor in a compressed air system is simplified by moisture vapor content chart in Bulletin M-7155. Units clean and dry compressed air with an internal condenser in combination with a disposable filter cartridge in a heavy-gauge steel casing. HANKISON CORPORATION.

405-Automatic air release valve

Air accumulations in pipelines that operate under pressure reduce the cross-sectional area of the pipe. Friction-head factor is induced, which lowers the capacity of the entire line. Automatic air release valves are described in Bulletin 1204. Includes a section on methods of installation. Eight pages. SIMPLEX VALVE & METER COMPANY.

406-Water treatment plant controls

Instrument control for water treatment plants is illustrated and described in Bulletin 90-241-10. Two-page flow sheet graphically illustrates most of the instrument applications possible in a large water treatment system. Operation of rapid sand filters through modern instrumentation and operation of the filter table are described. Twelve pages. FISCHER & PORTER COMPANY.

407-Separator data file

Complete data file with information pertinent to the interests of each reader accompanies Catalog 112-171, which discusses how the separator works and what it has to offer. Separators for every screening need are illustrated. Engineering data are included. Twenty-two pages. SEPARATOR DIVISION, SOUTHWESTERN ENGINEERING CO.

408-Firing equipment selection chart

Package steam generators in sizes 10,000 to 46,000 pounds steam per hour are described in Bulletin PG-55-3. Chart is included with capacities, dimensions, construction features, accessories, sectional drawings, and installation, photographs. Sixteen pages. FOSTER WHEELER CORPORATION.

409-Drafting equipment buying guide

Helpful buying guide for drafting machines, drawing boards, T-squares, parallel rules, and all drafting equipment. Thirty-two pages. FREDERICK POST COMPANY.

410-Constant-torque speed variator

Line of speed variator drives with constant-horsepower input ratings has been supplemented by nine more models for constant-torque applications. Drive provides infinitely variable output speed over a range up to 9:1 from a constant speed power source. Description is presented in Bulletin K-200. Eight pages. THE CLEVELAND WORM & GEAR COMPANY.

411-High-pressure reference

Quick reference numbering system is big feature of Catalog 2055. It fully describes line of high-pressure valves, adaptors, reactors, thermocouplings, gauges, fittings, and tubing. Twenty-six pages. HIGH PRESSURE EQUIPMENT COMPANY, INC.

412-Water screen data form

Description of how traveling water screens remove destructive floating debris and suspended matter from water by straining them from the influent channel is offered in Bulletin 885. Complete specifications and a data form for estimating purposes are included. Four pages. THE JEFFREY MANUFACTURING CO.

413-Stainless steel weld data card

Engineers interested in the use of stainless tubular products will want this new data card that gives stress rupture properties at high-temperatures of chromium-nickel stainless steel weld deposits. Results of an extensive study. THE BABCOCK & WILCOX COMPANY.

414-Water treatment precipitator

Of interest to all engineers dealing with water, its reuse, and conservation. Bulletin 2204C describes the many applications, principles of operation, and design features of the precipitator. Twenty pages. THE PERMUTIT COMPANY.

415-Stainless steel data book

This new data book is a must for every engineer's library. Design and dimensional information on flange drilling templates, flange and ring-joint facings, stainless steel pipe, pipe threads, pressure-temperature ratings and conversion factors, resistance to fluid flow, hardness conversion tables, physical, and me-

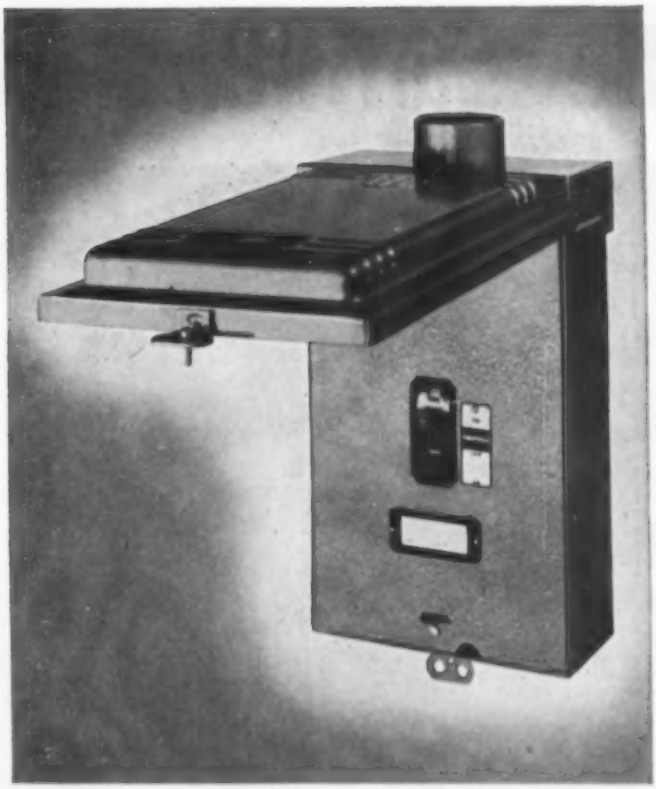
(more new bulletins on page 22)

New Line of I-T-E Enclosed Circuit Breakers approved for service equipment and commercial buildings

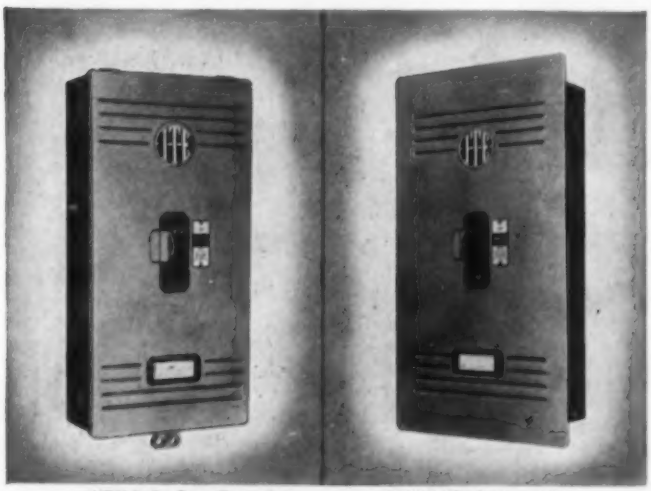
Ratings: 15 through 200 amp.

2 and 3 pole, 240 v a-c, 125/250 v d-c; 600 v a-c, 250 v d-c

Bonderized Dimenso finish makes enclosures eye appealing and durable. Card holder permits easy circuit identification. For more details, ask your I-T-E representative or authorized distributor for the Speedfax Catalog. Or write Small Air Circuit Breaker Division, I-T-E Circuit Breaker Company, 19th and Hamilton Sts., Philadelphia 30, Pa.



NEMA 3 has automatic cover latch which retains cover in fully open position, is equipped with inner dead front sheet which isolates breaker and wiring.



NEMA Surface Type 1 **NEMA Flush Type 1B**

For general indoor use where normal atmospheric conditions exist. The breaker operating handle extends through the cover, which mounts a locking bracket.

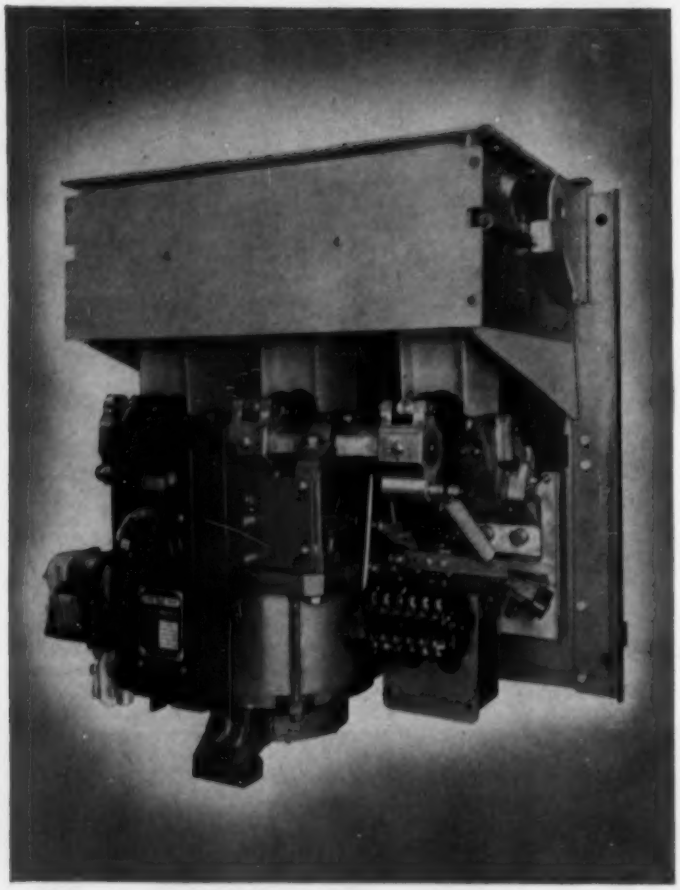
NEMA Type 3

For outdoor use to provide protection against driving rain, snow or sleet. Enclosure is equipped with threaded conduit hub, and matching knockout on bottom.

I-T-E CIRCUIT BREAKER COMPANY • **Small Air Circuit Breaker Division**

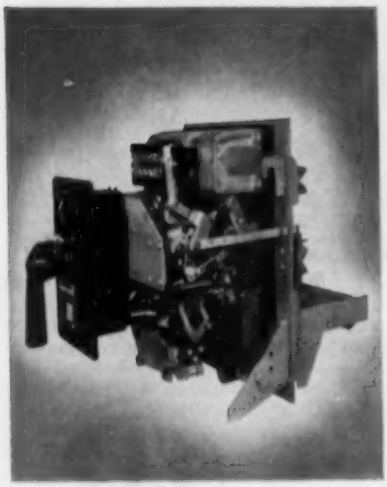
Circle 113 on READ-N-CIRCLE card for more data

News of new developments in

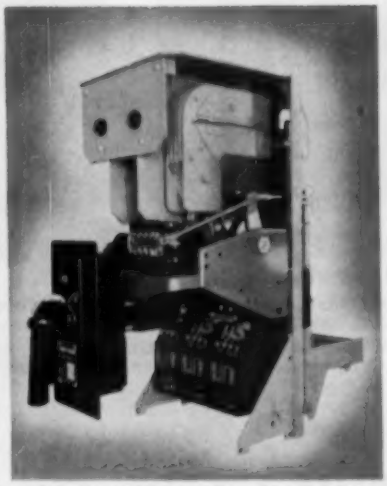


K line of circuit breakers now made through 3000 amp continuous, 75,000 amp interrupting at 600 v a-c

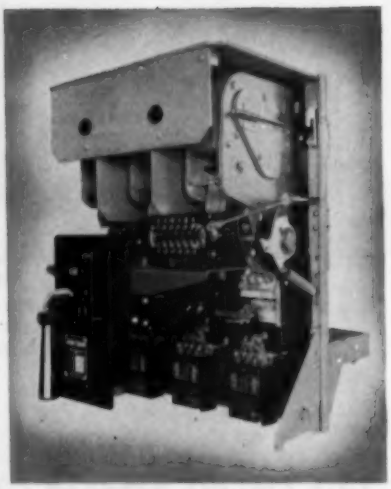
The new Type KD Air Circuit Breaker extends I-T-E's established three-high line of K breakers. It is an extremely compact metal panel breaker which incorporates the proved performance and generous safety factor of the KA, KB and KC breakers. As an integral part of I-T-E switchboard design, it offers the additional advantage of accessibility in minimum space.



KA Circuit Breaker



KB Circuit Breaker

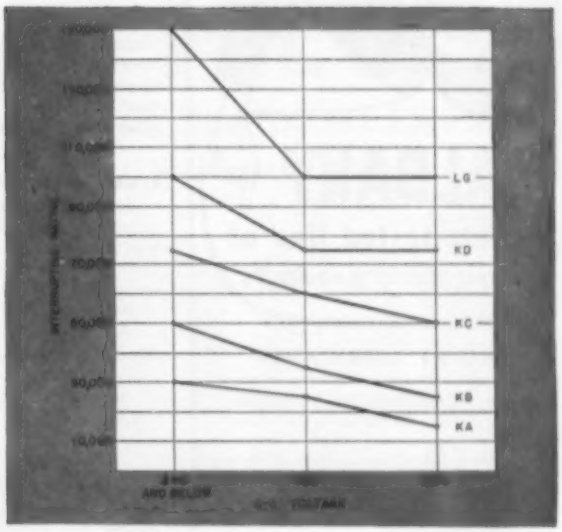


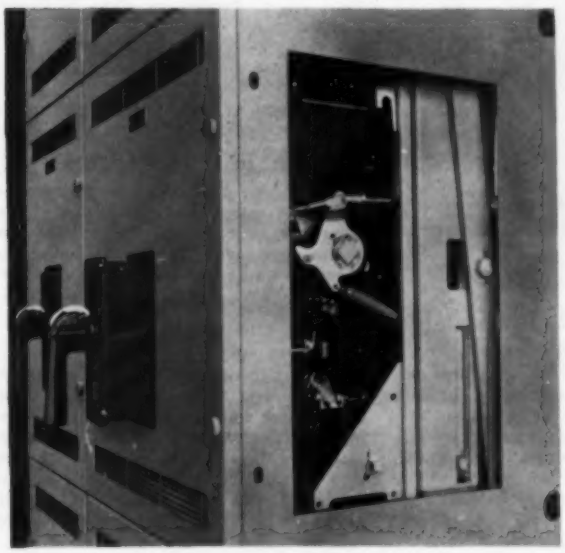
KC Circuit Breaker

I-T-E Low Voltage Switchgear

Circuit breaker interrupting ratings increased in keeping with proposed industry standards ▶

You save, because these standards reduce switchgear costs by permitting the use of lower interrupting rating breakers for short circuit protection in 240 v a-c and 480 v a-c systems. And with smaller breakers you save space, too. Uprating of I-T-E Types KA, KB, KC, KD and LG Air Circuit Breakers is shown in the accompanying chart.





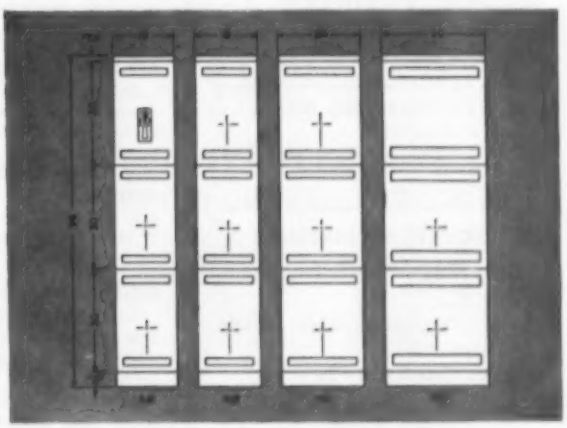
◀ Test position with doors closed now standard on new switchgear

Test position with no increase in over-all switchgear depth! This facility is by far the most convenient, most compact design on the market. It is an exclusive with I-T-E Switchgear, yet it costs no more. Additional advantages are increased safety, reduced maintenance, improved cleanliness, easier circuit identification.

New compact breaker design saves space ▶

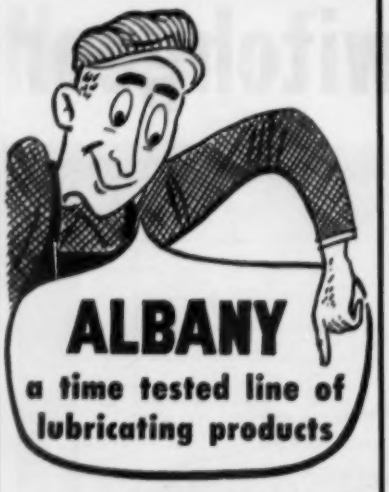
All I-T-E Type K Circuit Breakers can now be assembled three-high. KA, KB and KC frame widths remain the same as before. However, the new KD breaker is 6 in. narrower than the old LG frame, and can be arranged in a three-high compartment, space being thus provided for instrumentation in the same frame.

For complete information, contact your nearest I-T-E field office. Or write I-T-E Circuit Breaker Company, 19th and Hamilton Sts., Phila. 30, Pa.



I-T-E CIRCUIT BREAKER COMPANY · Switchgear Division

Circle 114 on READ-N-CIRCLE card for more data



ALBANY

a time tested line of lubricating products

ALBANY LUBRICANTS

ALBANY PRESSUREGREASE UNIVERSAL
For Cups — Ball Bearings — Water Pumps — Universal Joints. Waterproof — Exceptionally high melting point. Soft enough for gun application.

ALBANY GREASE
A cooling lubricant for operating temperatures from 110° F to 200° F.

ALBANY PRESSUREGREASE
A superior waterproof mineral oil grease of high viscosity. Comes in Liquid, Soft, Medium, Hard and Graphite. Pressuregrease Soft and Medium.

ALBANY BEARING LUBRICANT
(Ball or Roller Bearing)
Will not separate or oxidize assuring long life to bearings. May be used in hand grease guns.

ALBANY GEAR LUBRICANTS
Retards wear, quiets gears. Waterproof. Will not drip when gears are idle or in motion.

ALBANY PENETRATING OILS
(Clear or Graphite)
Quick-acting. Cuts rust as well as lubricates. Loosens sticky valves, eliminates squeaks.

ELECTRICAL DIVISION

Albany RBR Wire Pulling Compound

Albany Improved Cable Pulling Compound

Stearine Candles & Flux

Your Supply House Has These Items In Stock

1868-1955

BUT MORE MODERN THAN EVER

ADAM COOK'S SONS, Inc.
Mfrs of Albany Lubricating Products
LINDEN, NEW JERSEY

Circle 122 on READ-N-CIRCLE card

new bulletins

. . . starts on page 18

chanical properties of stainless steel are covered. Detailed materials selection chart for more than 300 corrosive solutions is included. Sixteen pages. COOPER ALLOY CORPORATION.

416-Do-it-yourself floor survey

New plan whereby maintenance engineers can secure accurate, free information about their flooring problems is described in Form 1025. In filling out the form, size and condition of the floor, type of traffic, possible outage time, and other pertinent data are listed. The report is then studied, analyzed, and definite recommendations for a complete cure are given without any obligation. THE MONROE COMPANY, INC.

417-Expansion joint specifications

Flexible metal hose and corrugated expansion joints are described in Bulletin 149. New specifications are given on expansion joints, including tables on anchoring and guiding. Eight pages. FLEXONICS CORPORATION.

418-Stainless tubing data folder

Information of value to engineers using stainless tubing and pipe is presented in Data Folder TB-355. Tables of analyses, mechanical properties, creep strength, physical properties, and oxidation resistance of nine stainless tubing steels are included. Six pages. THE BABCOCK & WILCOX COMPANY.

419-How to select temp control

Temperature ranges and other properties of liquid expansion, gas-pressure, and vapor-pressure filled systems are tabulated to aid in selection of control systems for any application in Catalog 12-A-10. Line of instruments for indicating, recording, controlling, transmitting, compensating, and programming temperatures from −400 to +1000 °F are also described. Twenty-four pages. FISCHER & PORTER CO.

420-Automatic grease monkey

Bearing design features new metering plate to automatically regulate grease flow to bearing and provide pressure relief against overgreasing. Discussed in Bulletin A-2406. Bearing is used on the company's a-c and d-c motors. Design assures that bearings are reliably lubricated, regardless of the service to which the motors are put. Four pages. RELIANCE ELECTRIC & ENGINEERING COMPANY.

421-Cold-applied tar coating

Versatile, heavy-duty coating provides excellent protection for metals and masonry against very corrosive vapors, mineral acid, alkaline waters, and extreme moisture conditions. Discussed in Bulletin PC5-355. Specifications and directions for application are given in detail. Four pages. PITTSBURGH COKE & CHEMICAL COMPANY.

422-Corrosion costs money

Treatment of industrial equipment to control corrosion cannot be a hit-and-miss proposition, according to Bulletin 290112. Examples of optimum control measures that may avoid costly, unsound treatment procedures are given. These measures may include minor physical changes as well as improvements in chemical treatment. Six pages. HALL LABORATORIES, INC.

423-Pocket size water testing kit

Water hardness can now be measured to the nearest 0.2 grain per gallon in an on-the-spot test that takes only one minute. Three-ounce kit consists of a glass vial and a bottle of reagent, is contained in a white plastic box that easily fits the pocket. Complete details of the Zeo-Kit are given in Bulletin 7RE55. CALGON, INC.

424-Redesign your steam generation

Packaged auxiliaries, such as economizers or air heaters, can pay for themselves soon when correctly installed. Complete line of watertube boilers and auxiliaries including water-cooled furnaces, superheaters, economizers, air preheaters, and steam washers are briefly described in this bulletin. Contains diagrams, tables, and boiler data. Twelve pages. EDGE MOOR IRON WORKS, INC.

425-Cyclones for thickening slurries

What the cyclone or hydraulic centrifuge is, how it was developed, how it is made, and how it works are all described in this well-illustrated bulletin. Uses, advantages, and typical applications are discussed. Eighteen pages. HEYLAND AND PATTERSON, INC.

426-New long-life plug valves

Extra long valve life is assured by close tolerance between sealing surfaces of this

valve that turns easily because the plug is floated on Teflon. Bulletin 39-5 describes the controlled-pressure lubricant system, built-in means of preventing sticking, and triple head seal. Good for 200-psi oil, water, gas, or 150-psi steam. Twenty-eight pages. HOMESTEAD VALVE MANUFACTURING COMPANY.

427-Welding guns work better, faster

Automatic and manual, air- or water-cooled welding guns are described in Catalog 2350. Shielding gases, control equipment, accessories, and wire also are covered. Schematic diagram shows automatic welding setup. Sixteen pages. AIR REDUCTION SALES COMPANY.

428-Plunger pump rating chart

Data on size, speed, displacement, and discharge pressure of various pumps is featured in Bulletin W-414-B45A. Pumps are suitable for water flooding and salt water disposal, hydraulic press and descaling systems, and many industrial pumping applications. Twelve pages. WORTHINGTON CORPORATION.

429-Atomizing deaerating principles

Requirements and principles of deaeration by atomization are described in Bulletin 4635. Sectional drawing in color shows water and steam flow during operation. Combinations in heaters and storage tanks are illustrated with photographs. COCHRANE CORPORATION.

FREE COPIES

For free copies of these handbooks, bulletins, and catalogs just circle the key numbers on the READ-N-CIRCLE card on page 83.

430-Roadable rail car switcher

Roadable rail car switcher utilizes box car's weight through weight transfer to obtain traction. Other features including a coupler that gives positive connection between the switcher and the rail car, plus fluid drive are also described. Four pages. HEMCO MANUFACTURING, INC.

431-Transformer connection diagrams

Diagrams and explanations of transformer power and lighting connections are offered in Bulletin CS-102. Common single-phase applications are covered. Also included are typical connections demonstrating the importance of open delta or wye hook-ups during emergencies when it is necessary to maintain continuous service in spite of transformer failure. Eight pages. KUHLMAN ELECTRIC COMPANY.

432-Air condition your powerhouse

New line of central-station, cabinet-type air conditioning units are described in Bulletin 8127. Ten-page section shows tables and graphs that enable engineers to determine the exact type of unit required for their installation. Variety of

Clean Oil

SAVES YOU MONEY!

HILCO

OIL MAINTENANCE EQUIPMENT

. . Keeps your Oil and Equipment Clean

FILTER

Furnished in capacities from 0.1 to 750 gpm. Various cartridges available for mineral and inhibited detergent oils.

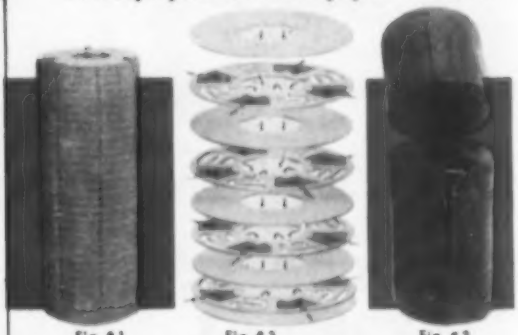


Fig. # 1 Fig. # 3 Fig. # 2

HILCO FILTER CARTRIDGES

The result of much research in the field of lubricating, fuel and industrial oil filtration, the new patented HILCO Filter Cartridges meet the need for tremendous filtering area, low pressure drop and high dirt storage capacity. Above: Fig. 1 is a new cartridge; Fig. 2 is a used cartridge (note that pockets are completely filled and the outer surface covered with solids); Fig. 3 shows the flow of oil, the dark area represents dirty oil passing into the pockets while filtered oil (white area) passes into "S" shaped section.

HILCO Purification Means Complete Oil Purification . . .

You get absolute removal of sludge, acids, carbon, water and fuel dilution with a properly selected HILCO. Clean oil saves you money. Expensive maintenance is reduced, equipment shut-downs practically eliminated, lost man hours and cuts in production become a thing of the past. HILCO continuous, all electric, automatic purification keeps your oil clean and in top condition at all times. You receive the full capacity and economy of your equipment.

HILCO offers a wide range of oil purification units to meet every oil conditioning problem. HILCO units are manufactured in both stationary and portable models. Write us about your purification needs . . . recommendations are given with no obligation. Let HILCO put its 25 years of experience in oil purification to work for you.

THERE'S A HILCO FOR EVERY LUBRICATION AND FUEL OIL FILTERING PROBLEM

Oil Reclaimer

Purifier Re-Refiner

High Capacity Reclaimer

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Whatever your heating job may be, you'll find the efficient, economical answer in . . .

CHROMALOX Electric Heaters

. . . for heating platens, dies, molds, metal parts . . . for heating liquids, air, gases . . . for curing, drying, baking . . . for comfort heating in offices and factories . . . for special applications . . . in fact for any application requiring fast, low-cost, controlled heat up to 1100°F.

IMMEDIATE DELIVERY

from the world's largest factory stock of industrial electric heaters . . . over 15,000 types, sizes and ratings.

Let the Chromalox Sales-Engineering staff solve your heating problems . . . electrically.

Write for your copy of Catalog 50

Contains helpful information on design uses, and prices of Chromalox Electric heaters, elements, thermostats, contactors and switches.

To get some interesting facts about additional applications of electric heat, ask for Booklet F1550—"101 Ways to Apply Electric Heat."

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☐ A copy of "101 Ways"
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A-4459A

Circle 101 on READ-N-CIRCLE card

new bulletins

. . . starts on page 18

unit arrangements to meet wide range of specifications and characteristics are illustrated with drawings. Twenty pages. AMERICAN BLOWER CORPORATION.

433-Dry fluid drive selection

Full color illustrations of the Flexidyne dry fluid drive plus cross-section engineering drawings, are offered in Bulletin A-640. Two methods of selection with easy-to-use selection charts and tables for recommended V-belt drives are included. Twelve pages. DODGE MANUFACTURING CORPORATION.

434-High static head pumps

Single-stage, double-suction centrifugal pumps for pumping against high static heads, are described in Bulletin 350-43. New purge-type grease lubrication feature, which lengthens bearing life, is described. Tables give specifications and performance data on pumps from 85 to 4500 gpm, and maximum heads to 195 feet. Six pages. AMERICAN-MARSH PUMPS, INC.

435-Conveyor belt slide rule kit

Two slide rules that cut the time required for designing a conveyor belt installation from three hours to ten minutes are now available. They are part of a conveyor belt construction kit. One is a horsepower calculator. The other is a carcass selector. They incorporate the engineering data contained in a 40-page conveyor belting notebook. UNITED STATES RUBBER COMPANY.

436-Optical aligning of turbines

Optical tooling instruments and accessories for alignment of power generators are described in a new catalog. Optical tooling systems are replacing tight-wire methods for aligning turbogenerator cylinders, pedestals, blade rings, diaphragms, shafts, and sole plates. FARRAND OPTICAL CO., INC.

437-Basic dust problems answered

The reason behind low first cost and low maintenance costs of the Roto-clone line of dust collectors is discussed in Bulletin 270-A1. The units take up less space than conventional units without losing efficiency. Six pages. AMERICAN AIR FILTER COMPANY, INC.

438-Water pump selection table

Condensed selection table is a valuable guide to horsepower and head-capacity ratings of vertical pumps for industrial primary water supply. Described in Bulletin 100. Sectional illustrations with enlarged views of special features describe pumps clearly. Distribution systems are covered. Eight pages. LAYNE & BOWLER PUMP COMPANY.

439-Filter cleaning is simplified

Tubular filters for simplified operation and low maintenance in smaller filtering problems are described in Bulletin TS-160-755. Features of the filters are described with photographs and a flow diagram. Four pages. INDUSTRIAL FILTER AND PUMP MFG. CO.

440-New concept in generators

Developments that bring the efficiency of the externally-regulated diesel electric set to a self-regulated set are described in Bulletin 31649. Advantages such as close regulation of voltage, easy starting, compact design, and versatility in application are also discussed. Four pages. CATERPILLAR TRACTOR CO.

FREE COPIES

For free copies of these handbooks, bulletins, and catalogs just circle the key numbers on the READ-N-CIRCLE card facing page 83.

441-Save on rewiring

Cables for flexible bus-drop power distribution are described along with tabular data in Bulletin DM5541. Directions for normal installations with overhead bus duct are also given. The cables permit fast, economical installation and relocation of machines without extensive rewiring. Four pages. ANACONDA WIRE & CABLE COMPANY.

442 Air filter facts and figures

New methods of filtration or conditioning lengthen air equipment as much as 500 percent and reduce repairs up to 87 percent. Revolutionary changes in the principles of air filtration are discussed and illustrated in this new catalog. Also covers installation and maintenance. Eighteen pages. MASTER PNEUMATIC, INC.

443-Germanium for mercury arcs

Germanium power rectifiers that are ideal to supply direct current of the magnitude now handled by mercury arc rectifiers are discussed in Bulletin GPR-1. Applications include anodizing power supplies, arc melting furnaces, Cyclotron and acceleration magnet supplies, lifting magnets, brakes and magnetic chucks, and pump power supplies for molten metals. Ratings and specifications are also listed. INTERNATIONAL RECTIFIER CORP.

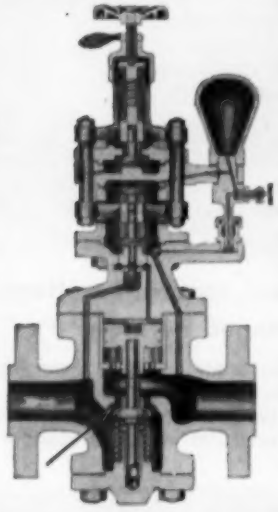
444-Laminated Teflon pipe

Physical and chemical properties of this pipe, manufactured from woven glass impregnated with Teflon, are included with piping specifications in Bulletin FTL-1. Detailed description of flanging and coupling the pipe in the field and suggested applications for this inert plastic pipe are also included. Four pages. RESISTOFLEX CORPORATION.

(more bulletins on page 80)

STELLITE'S *IN* EROSION'S *OUT*

No Erosion Here!



Arrow shows location of integral stellited seating surface in Leslie Pump Pressure Regulator.

Stellite as a *standard* seating surface for regulators and control valves in steam service is a Leslie exclusive. Combined with a hardened stainless steel main valve, stellite provides the most erosion resistant combination known, and is available in integral and renewable seating arrangements.

This unbeatable combination, pioneered in the field by Leslie, is the product of many years' experience and knowledge of proper stelliting and heat treating techniques. And with Leslie, it's *standard* in a wide range of regulators and control valves designed to meet any temperature or pressure requirements.

When erosion and wear are factors to consider, it will pay you to call your Leslie engineer to demonstrate how, with Leslie equipment, "Stellite's In — Erosion's Out".

TRADE LESLIE MARK

Write for Bulletin 552
"When To Use A Controller And When To Use A Regulator".

REGULATORS AND CONTROLLERS

LESLIE CO., 263 GRANT AVENUE, LYNDHURST, NEW JERSEY

B172

CONTROLLED QUALITY MEANS QUALITY CONTROLS

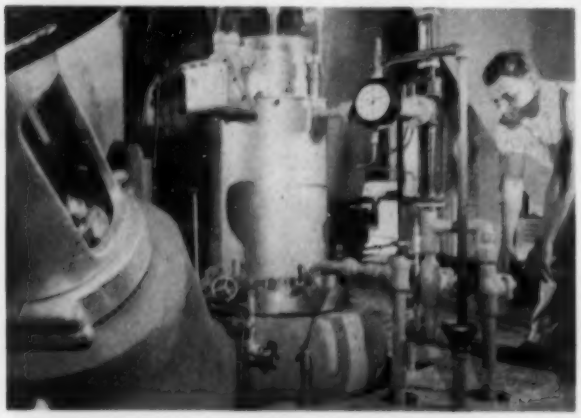
Circle 145 on READ-N-CIRCLE card for more data

ideas in action

. . . for industry & power

Canned motor-pump breaks into boiler house down in Virginia

Originally developed for atomic submarines, the canned motor-pump is finding industrial application for circulating boiler feedwater in a closed-loop system. A Westinghouse canned motor-pump at Possum Point generating station of the Virginia Electric Power Company circulates 4700 gpm of 605 °F water at 1725 psi continuously. It is driven at a constant speed of 1800 rpm by



a 150-hp, 440-volt, three-phase, 60-cps motor. The canned motor-pump is a hermetically-sealed unit that circulates liquid coolant or other fluids in high-temperature, high-pressure, closed-loop systems with zero leakage. All parts in contact with the circulated fluid are made of corrosion-resistant alloys. There are no external shaft seals. Suction and discharge nozzles are welded into the pipe that forms the closed-loop system. Fluid circulates throughout the pump drive motor, through the bearings (their only means of lubrication), and a magnetic gap. Windings are protected from the hot coolant by lining the stator bore with a cylinder or "can" of thin nickel-alloy sheet, welded leak-tight in place. The rotor is "canned" in a similar manner for the same reason. Beside being completely leak-proof, the pump is simple to install. It requires minimum instrumentation, and can operate without an injection water bleed. The absence of external shaft seals simplifies maintenance.

Boilers feed on plants' exhaust gases

Two catalytic petroleum cracking plants that use their own exhaust gases to make steam have been placed on stream by the Sun Oil Company. The cat crackers make use of special catalytic waste-heat boilers to burn their own flue gases, and generate a total of 100,000 pounds of process steam an hour. Secret of the cheap steam and low-cost air pollution protection is the oxidation catalyst known as Oxycat, manufactured by Oxy-Catalyst, Inc. The cost of the fuel that would be required to supply steam to the cat crackers, if it weren't for this system, would be $400,000 a year. The waste-heat boilers will pay for themselves in fuel savings within two years.

Switchboards have building-block design

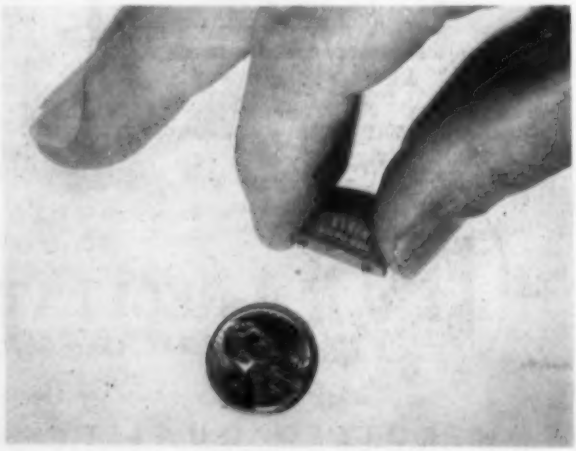
A new basic circuit concept in switchboard design, which involves the use of pre-engineered and time-tested basic circuits, has been announced by the General Electric Company. There are eleven basic circuits in the new design concept, which cover applications for the majority of switchboard users. Each circuit includes basic instruments, meters, control devices, and relays necessary to perform a desired function. The circuits are:

- ¶ A-c feeder with overcurrent protection
- ¶ A-c feeder with directional overcurrent protection
- ¶ Power transformer
- ¶ Tie line with pilot wire differential protection
- ¶ Transmission line with carrier current directional comparison protection
- ¶ Transmission line with directional distance protection
- ¶ Small a-c generator
- ¶ Large a-c generator
- ¶ Unit generator-transformer
- ¶ Bus differential protection
- ¶ Synchronizing equipment

A basic circuit switchboard can be selected easily from specification sheets which are available for each of these circuits. Provision is made for the addition of optional elements to the sheet, to satisfy commonly used variations.

Two years' constant voltage from tiny cell developed by Elgin

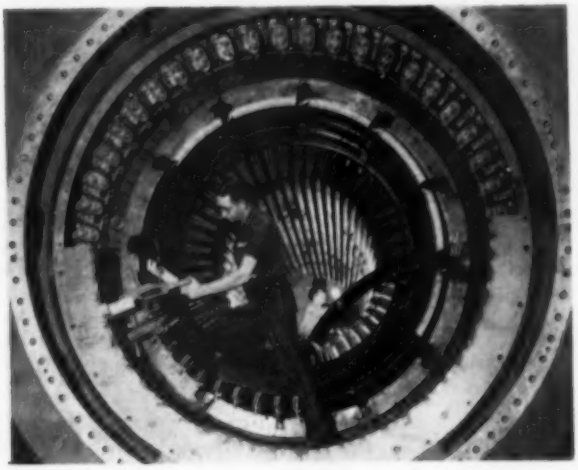
Expendable miniature cell developed by Elgin National Watch Company occupies about the volume of a penny, yet packs enough energy to operate miniature electronic devices at virtually constant voltage for two



years. The battery allows high current drainage without danger of "polarization." Secret of the development is the use of indium as an anode, which eliminates leakage and gassing, so that only a thin plastic case is required. The cell can be made in any shape or size to provide complete flexibility in the design of electronic equipment. Present cell delivers about 1.15 volts, compared with 1.35 volts for most other miniature cells, but this can be stepped up to 1.37 volts by using another cathode material.

Liquid coolant flows through stator windings of large generator

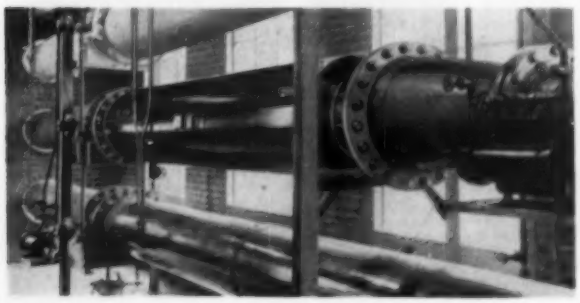
Significant increase in the capability of large-capacity generators is possible without increasing physical dimensions through the use of this cooling method—sending liquid coolant through stator windings. The first unit, rated 260,000 kva, has been almost completed by General Electric Company for the Eastlake powerplant of The Cleveland Electric Illuminating Company. The gen-

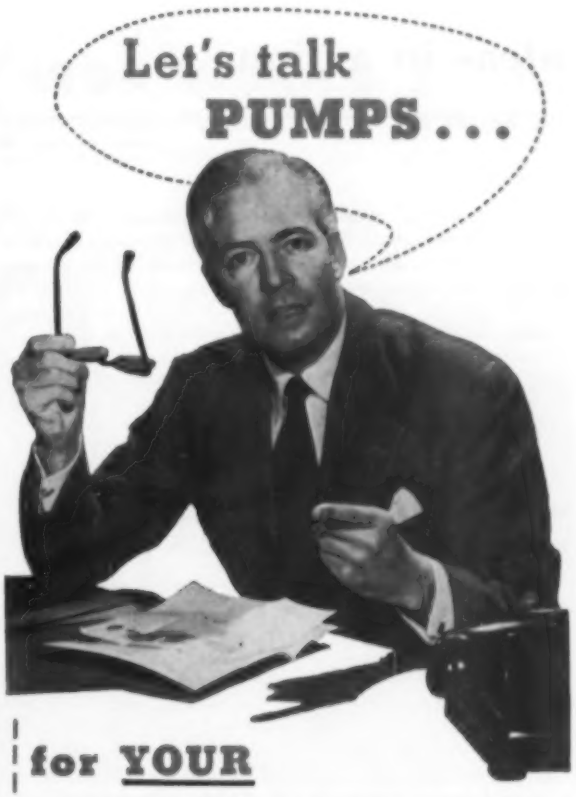


erator's high capacity results from this more efficient removal of heat produced during generation. Until recently, such generators would have been cooled by circulating hydrogen gas through passages in the magnetic portions of the rotor and stator. The Eastlake unit is one of the largest 3600-rpm steam turbogenerators in the world. It can supply the electrical needs of 700,000 people.

Pressure-reduction noise can be silenced

Noise caused by pressure reduction is no longer a problem in natural gas distribution and steam systems. Pipe ring and resultant noise radiation within the regu-





for YOUR
specific purposes!

Pumps become an intensely personal subject . . . when you find that certain types or makes can provide the kind of trouble-free service you need—thus saving you from expensive shut-downs!

When you talk pumps, consult a WEINMAN Centrifugal Specialist. He's the man with the know-how and experience to diagnose your particular problem and provide the kind of answer you want most . . . a pumping system tailored to your industrial requirements . . . one that renders year-in and year-out dependability, with minimum maintenance required . . .and yet keeps initial costs low.

The WEINMAN General Service Unipump—ideal for limited-space applications where liquids must be handled efficiently and economically.

WEINMAN Centrifugal Pumps are built by Centrifugal Experts . . . with long years of experience in the design and manufacture of centrifugal pumps to supply every industrial need . . . from small to large capacity in both low and high head models, and handling of all types of liquids even those carrying solids. Solve your pump problems today—write, wire or phone your nearest WEINMAN Centrifugal Specialist.

Representatives in principal cities

Built by Centrifugal Specialists
The WEINMAN Pump Mfg. Co.

Circle 154 on READ-N-CIRCLE card

ideas in action

. . . starts on page 26

lator system and over the surrounding area can be effectively eliminated. Newly developed Burgess-Manning PRS pressure reduction silencers remove 95 to 99 percent of the noise without restricting flow or causing pressure drop. Silencer is installed in the downstream piping close to the reduction valve so that noise is stopped at its source. Unit eliminates the need for expensive pipe lagging or subsurface burying of pipe to eliminate noise. Noise reduction at critical outdoor locations in gas distribution systems ranges from 18 to 25 decibels.

Insulating-finishing cement does better repair job, and does it faster

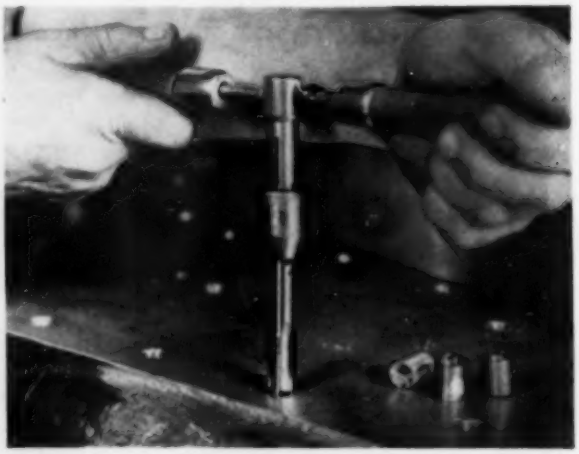
White spun mineral wool insulating-finishing cement was used recently to repair cracked insulation on the main boiler breeching in the powerplant of the U. S. Navy Aviation Supply Depot, Philadelphia. It simplified the repair job and avoided complete re-insulation. The repaired covering has a finished appearance as attractive as the initial job. Full insulating effectiveness has been restored.

The breeching was insulated 12 years ago with blankets and two ¼-inch layers of conventional finishing cement, but it had become badly cracked. Damaged portions of the cement and blanket were removed right down to the metal skin of the breeching, where necessary. Heavy-gage expanded-metal lath was secured to the welding studs that held the blanket. Baldwin-Hill Super Powerhouse insulating-finishing cement was applied over the lath to give a level, smooth finish. The cement was applied in varying thicknesses to level the exterior surface. After trowel finishing, the cement dried to an attractive glazed-white finish. The job was completed in jig time because the cement was quick-setting (initial set in two to three hours) and fast drying. It was applied in thicker layers than conventional finishing cement (up to 1 inch as compared to ¼ inch) and no shrinkage cracks have developed.

Steel threads in aluminum

A "weight vs. strength" problem has been solved by putting stainless steel wire thread inserts in aluminum. Threads tapped in unprotected aluminum tend to strip and wear. To guard against the possibility of screws working loose, stainless steel wire thread inserts, made by the Heli-Coil Corporation, are installed in over 200 holes on the surfaces of the rotary blower for one of

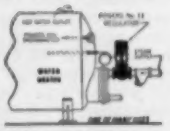
(more ideas in action on page 32)



End Hot Water Complaints • Stop Wasting Fuel

due to OVER-heated water

Install Powers No. 11 Self-operated temperature regulators. They prevent OVER-heated water, often pay back their cost 3 to 6 times a year and give years of reliable service. They are simple to install, dependable, economical. Write for Bulletin 329, prices and full information about this quality regulator. (e16)



THE POWERS REGULATOR COMPANY

Skokie, Ill. • Offices in 60 Cities • See Your Phone Book

Over 60 Years of Automatic Temperature and Humidity Control

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ERIE CITY
115 Years in Steam Generation

ERIE CITY IRON WORKS • *Erie Pa.*

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
UNDERFEED AND SPREADER STOKERS • PULVERIZERS

You can depend on Erie City for sound engineering

A NEW USE FOR STEAM at BREA CHEMICALS INC.

designed by **BREA CHEMICALS INC.**
constructed by **C. F. BRAUN & CO.**

Brea Chemicals, Inc. at Brea, California applies sound engineering to produce ammonia from air, water, and natural gas.

The air is washed clean of carbon dioxide with caustic; compressed, dried, and liquified. The liquid air is fractionated, and the overhead nitrogen product is one of the basic materials for ammonia synthesis.

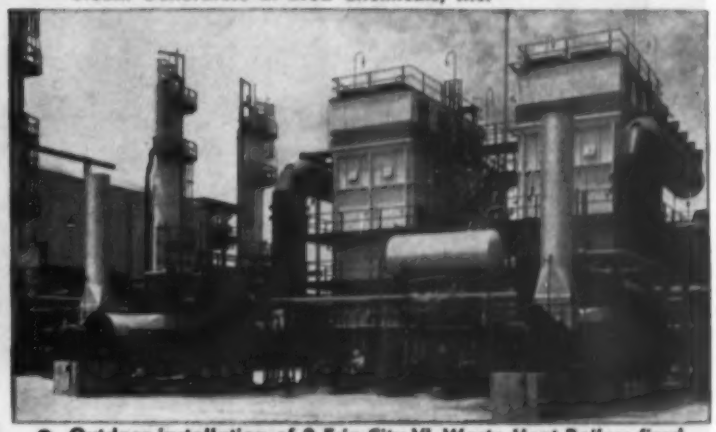
Water is added to three Erie City VC Steam Generators and becomes steam. Part of this steam reacts with natural gas in a reforming furnace. The effluent gas contains hydrogen, oxides of carbon, and methane. The flue gases from the furnace are used as a source of waste heat to operate two Erie City VL steam generators. The steam from these generators augments plant steam requirements at low cost.

Carbon dioxide is removed from the reformed gas by scrubbing with a liquid amine solution, recovered, and processed to form dry ice. The carbon monoxide and methane are removed by scrubbing with liquid nitrogen. The overhead product from the nitrogen wash column is a mixture of hydrogen and nitrogen ready for the synthesis operation.

Ammonia from the Brea process provides the foundation for servicing the farmer with aqua ammonia, aqua ammonium phosphate, and ammonium sulfate, and in the near future—ammonium nitrate.

Erie City through the application of sound engineering in the design of its products, is proud of the part it plays in this new petrochemical industry.

● Outdoor installation of 3 Erie City VC 50,000 #/hr. gas fired Steam Generators at Brea Chemicals, Inc.



● Outdoor installation of 2 Erie City VL Waste Heat Boilers fired by flue gases from the Reform Furnaces shown above.

● Air view of the Brea Chemicals Inc. Ammonia Plant at Brea, Cal.

Circle 104 on READ-N-CIRCLE card for more data

"We eliminated Motor Burnouts and cut new installation costs – by using Fusetron dual-element Fuses!"

"Our organization services some 43 Alfalfa Mills in the central Nebraska area.

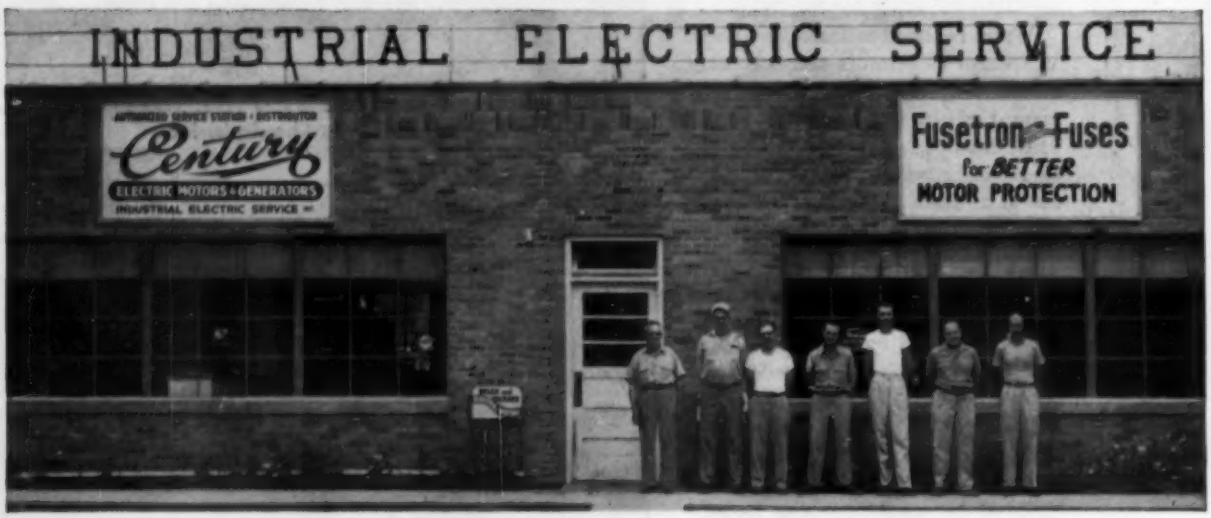
"We know, from experience, that overloads and single phasing are two of the most common causes for motor failures in these mills.

"In order to give these motors the protection they need, we use Fusetron fuses in motor-running protection sizes. As a result, we have eliminated motor burnouts for our customers.

"In addition, on new installations, we have found that smaller switches can be used with proper size Fusetron fuses.

"We can pass this substantial saving along to our customers and still give them safer protection than can be had with ordinary protective devices."

Max T. Moore, Vice-President
Industrial Electric Service, Inc.
Kearney, Nebraska



Here's why Fusetron dual-element fuses give DOUBLE protection to large motors

Of course, large motors are protected with thermal cutouts or overload relays. But experience has shown that such devices sometimes stick or fail to operate. When they do, the motor burns out.

On normal installations, by replacing fuses used for short-circuit protection with Fusetron fuses of motor-running protection size, you get the same short-circuit protection PLUS double protection against motor burnout from overload or single phasing.

If thermals or relays fail to operate for any reason, the Fusetron fuses will act independently to SAVE THE MOTOR.

And Fusetron fuses protect against waste of space and money — permit use of proper size panels and switches.

On motor circuits Fusetron fuses can be used in sizes near to the operating load. That cannot be done with ordinary fuses. It is possible with Fusetron fuses because they have a tremendous time-lag that prevents them from opening on starting currents or other harmless overloads.

This means that on new installations for motor circuits you can save space and money because *proper* size Fusetron fuses permit using *proper* size switches and panels instead of *oversize*.

You too, can profit by the 10 point protection of Fusetron fuses

1. High interrupting capacity — protect against heaviest short-circuits. Have proven on tests to open safely on circuits set to deliver in excess of 100,000 amperes.
2. Protect against needless blows caused by excessive heating — lesser resistance results in cooler operation.
3. Protect against needless blows caused by harmless overloads.
4. Provide thermal protection — for panels and switches against damage from heating due to poor contact.
5. **Protect against waste of space and money — permit use of proper size switches and panels.**
6. **Protect motors against burnout from overloads.**
7. **Give DOUBLE burnout protection to large motors — without extra cost.**
8. **Protect motors against burnout due to single phasing.**
9. Make protection of small motors simple and inexpensive.
10. Protect coils, transformers and solenoids against burnout.

For more information on Fusetron fuses write for bulletin FIS.

On new construction, tell your architect to specify this Safer, Better Protection.

FOR LOADS ABOVE 600 AND UP TO 5,000 AMPS . . . USE BUSS HI-CAP FUSES

They have unlimited interrupting capacity to handle any fault current regardless of system growth.

They can be coordinated with Fusetron fuses on feeder and branch circuits to limit fault outages to circuit of origin.

Write for bulletin HCS.

BUSSMANN MFG. CO. (*Division of McGraw Electric Co.*) UNIVERSITY AT JEFFERSON ST. LOUIS 7, MO.

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

Circle 115 on READ-N-CIRCLE card for more data

IT'S EASY TO MAKE

Repairs

LIKE THESE...

Just mix and fix—it's easy with Smooth-On No. 1 Iron Cement. You can seal cracks in pipes, boilers, metal containers . . . tighten loose screws and fixtures in wood, metal or tile . . . anchor bolts in concrete. Smooth-On expands as it sets and hardens like iron. Makes a tight, lasting repair that virtually becomes a part of what it fixes. Keep a can on hand (Smooth-On doesn't deteriorate) and use it as you need it—at a cost of only a few pennies per repair.

FREE
REPAIR HANDBOOK

New, completely revised, 48-page illustrated handbook has hundreds of time and money saving repair tips for jobs in the plant and around the home. Millions of these repair handbooks have been distributed during our 58-year history. Write for your copy today.

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SMOOTH-ON MANUFACTURING CO.
DEPT. 19, 570 COMMUNIPAW AVE., JERSEY CITY 4, N. J., U.S.A.

SMOOTH-ON
THE IRON CEMENT OF MANY USES

Circle 132 on READ-N-CIRCLE card

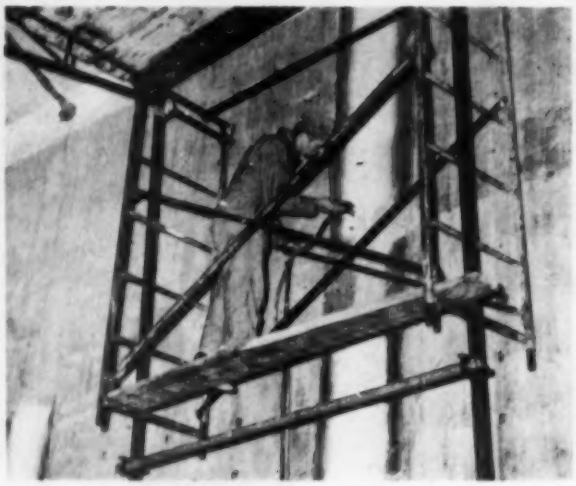
ideas in action

. . . starts on page 26

Fairbanks-Morse's stationary diesel engine lines. Holes are drilled at the same time the casting is machined. Then the threads are tapped and the inserts wound in. This provides hard, smooth, permanent threads ready to receive the machine screws. The external threads of the inserts are self-anchoring against the aluminum threads of the casting, so the inserts remain in place for the life of the blower. The screws can be easily removed for maintenance without danger of damaging the threads.

Leaks in reservoir plugged with plastic

Excessive water seepage through expansion joints of a new 25,000,000-gallon reservoir at Omaha, Nebr., was stopped by coatings based on Bakelite vinyl resins. Elastic, moisture-resistant membranes formed by the coatings expand and shrink with the joints they cover, cutting leakage to a mere trickle. The reservoir is nearly two blocks long, one block wide and 35 feet deep. It is constructed of reinforced, vibrated concrete and lies 80 percent below grade level. A copper drip basin system was incorporated between the reservoir's double floors to trap

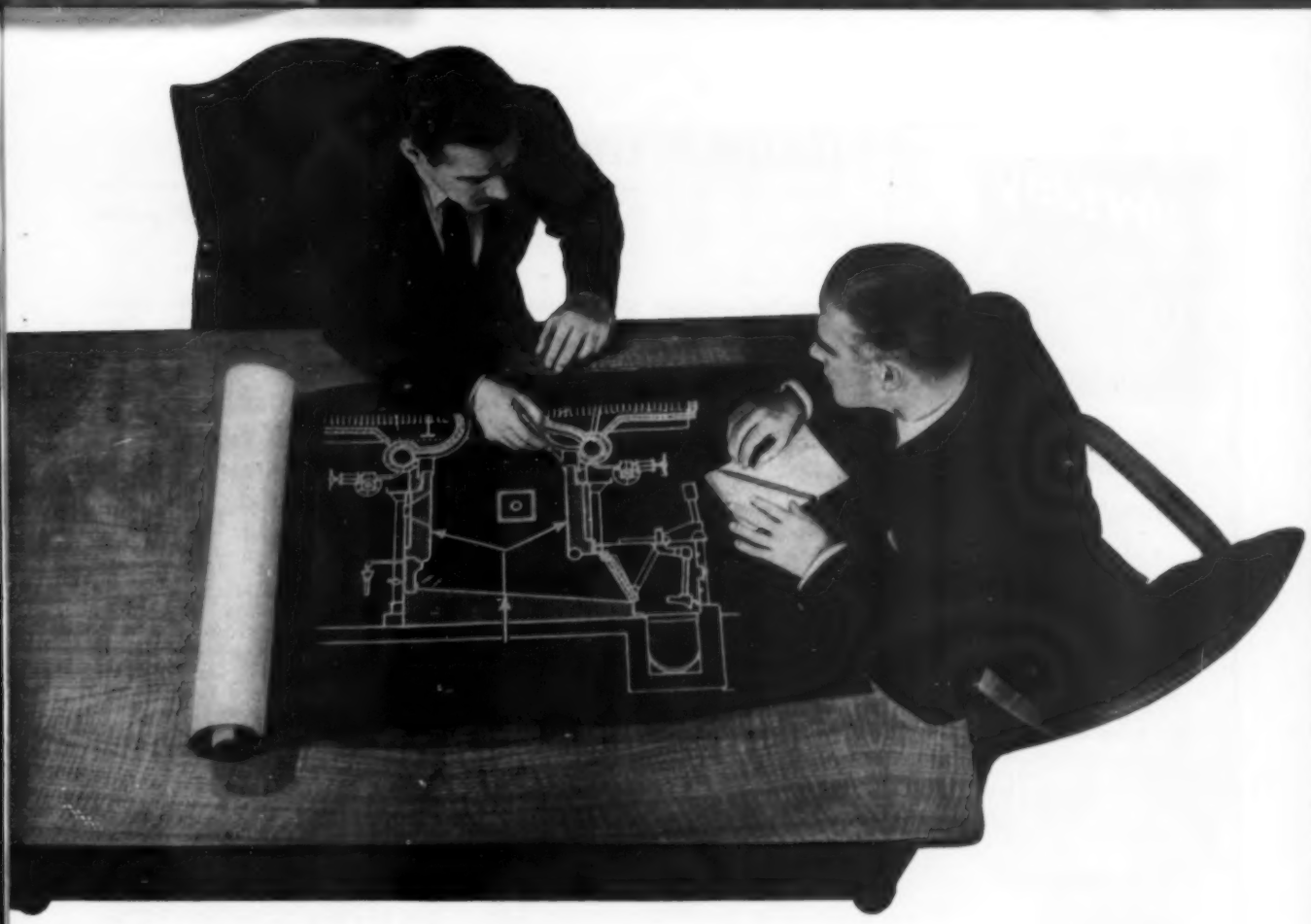


an expected hydrostatic leakage of 12 to 15 gpm. However, leakage at many times that rate resulted when new surfaces were contracted by incoming water that cooled them as much as 22 °F. The coatings were sprayed over miles of joints inside the reservoir to form a continuous membrane over the concrete surface, bridging porosity and minor cracks as well as expansion joints. The treatment has reduced total leakage to a mere 1½ to 2 gpm.

Make your own static detection device

Maintenance and safety engineers can easily check for static electricity around V-belts by holding a 1/25th watt neon glow bulb near the belt, according to researchers of Dayton Rubber Co. The bulb will light if there is static electricity around the belt. On dry days, when static is

(more ideas in action on page 37)



PROMINENT PUBLIC UTILITY

Cuts ashpit maintenance with B&W Refractory Concretes

A trial installation of B&W Refractory Castable "A", a 2600 degree refractory concrete, was made in one boiler ashpit. To date this castable has given 25 months more maintenance-free service than the refractories previously used.

Results of this first trial were so encouraging that another ashpit, shown in the drawing above, was lined with B&W Refractory Castable "A". In this installation the two opposing high velocity water sprays cut refractories life two ways. First, water splattered on the hot walls (about 1800F) caused spalling. Second, the high velocity water jets had an abrasive effect on the floor refractories.

Here's the report: "After 20½ months service, B&W's Castable "A" lining was still in excellent condition—far superior to the refractories used before."

On the basis of these trials three other boiler ashpits have been lined with this 2600 degree castable.

In addition to ashpit linings, B&W Refractory Castable "A" is widely used in boilers for baffles, hearths, door linings, special shapes, repairing eroded brickwork and forming pier walls in stoker-fired boilers.

B&W Castable "A" is only one of a line of B&W Refractory Concretes which cost-conscious boiler operators are putting to increasing use in many different applications. These B&W Concretes may help you cut installation costs and lengthen furnace life. Consult your B&W Field Engineer.

BABCOCK & WILCOX

THE BABCOCK & WILCOX CO.
REFRACTORIES DIVISION
GENERAL OFFICES: 161 EAST 42nd ST., NEW YORK 17, N.Y.
WORKS: AUGUSTA, GA.

B&W REFRACTORIES PRODUCTS — B&W Allmul Firebrick • B&W 80 Firebrick • B&W Junior Firebrick • B&W Insulating Firebrick B&W Refractory Castables, Plastics and Mortars • OTHER B&W PRODUCTS—Stationary & Marine Boilers and Component Equipment . . . Chemical Recovery Units . . . Seamless & Welded Tubes . . . Pulverizers . . . Fuel Burning Equipment . . . Pressure Vessels . . . Alloy Castings

R470A

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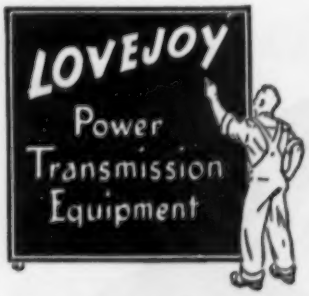

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No lubrication required. Quickly installed. Easily replaced. Cushions are reversible—can be changed or reversed without shutdown. Fractional to over 2400 hp. Light, medium or heavy duty.

Variable Speed Pulleys:

Quickly installed on new or old equipment. Change speed while machine is running. Ratios to 3 to 1. Fractional to 15 hp.

Select-O-Speed Transmissions:

Economical as compared to other variable speed transmissions. Instant adjustment over wide range of speeds. Hand wheel or lever control. Ratios to 10 to 1. Fractional to 5 hp.

Universal Joints:

Precision ground. Finest alloy steel. No binding, backlash or end play. 13 sizes, fractional to 207 hp. Bores ¼ to 2 in. Lengths 2 to 10½ in.

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names make news

. . . personalities from industry & power

Bart Manufacturing Corporation has appointed **James P. McNally** as its sales manager. Before joining the sales force he was metallurgical technical advisor on the forming and fabrication of nickel plated steel.

Rusk

Gerlitz

Kerby Saunders, Inc. has appointed **Glenn O. Rusk** as manager of its Process and Power division.

Simplex Valve & Meter Company has appointed **Frank E. Gerlitz** to the position as vice president in charge of sales. He joined the company as sales engineer in 1940.

Allis-Chalmers Manufacturing Company has named five engineers to positions in its Power Equipment division. **Edward J. Gaffney** is assigned to the nuclear power department, **Berton D. Moldow** and **James W. Thomas** to the switchgear department, **Edward T. Norton** to the transformer department, and **Herbert M. Wall** to the motor and generator department. **R. R. Goetz** has been appointed assistant supervisor of mechanical service and erection, and **Alfred C. Bafaro** has been assigned as serviceman for New England region.

U.S. Hoffmann Machinery Corporation appointed **Charles A. Wallace** manager of its Industrial Filtration division. Before joining the company 24 years ago, he had been a machine tool engineer and an automotive engineer. He is a graduate of M.I.T.

Federal Power Commission has announced that **William R. Connole** has taken office as a member of the commission for the term expiring June 22, 1960. Mr. Connole succeeds **Commissioner Nelson Lee Smith.**

Machinery & Allied Products Institute has elected **Charles W. Stewart, Jr.,** as its new president. Amongst those elected to the Executive Committee were **Robert C. Becherer** (president, Link-Belt Company), **Robert E. Friend** (president, Nordberg Manufacturing Company), **S. E. Lauer** (president, York Corporation), **Gordon Lefebvre** (president, The Cooper-Bessemer Corporation), **Edwin J. Schwanhausser** (president, Worthington Corporation), **James P. Stewart** (president, DeLaval Steam Turbine Company), and **Brinton Weiser** (vice president, Chain Belt Company).

Thomas A. Edison, Incorporated has added eight new members to the staff of the Edison Research Laboratory. **Robert C. Puydak, Houchang Handjani, Donald Tuomi, Gerald J. B. Crawford,** and **Bernhard J. Bastian** have joined as research engineers, and **Miss Juliana D. Sareske** and **Mrs. Elizabeth M. N. Bovard** as research chemists. **Dennis Howard Howling** has joined the staff to help in the development of heat measurement and control. He produced and used the first absolute carbon resistance temperature scale below 1°k.

J. A. Zurn Mfg. Co. has promoted four of its executive personnel. **Thomas A. Kennedy** becomes assistant to the president, **John Henry Zurn** becomes vice president-general manager, **Albert A. Baker** is vice president-sales, and **John L. Derby** is director of manufacturing.

Lee

Neumann

General Electric Company has named **Thomas E. Lee** manager of a newly organized Industrial Switch and Component Device Engineering sub-section. He will be responsible for the design and production engineering of G.E.'s industrial safety switches and a wide variety of component switches for panelboards, switchboards and other products.

The Permutit Company has appointed **William C. Neumann** as chemical research engineer in its Special Applications department. He is a member of the American Institute of Chemical Engineers.

Circle 138 on READ-N-CIRCLE card for more data

Painting, courtesy Power Magazine

New J-M Color Code

identifies metal in Spirotallic® Gaskets

Most engineers know that Spirotallic Gaskets maintain a perfect seal despite extreme fluctuation in fluid pressure and flange compression. Consequently, these gaskets are used in a wide range of service conditions which include high temperatures, elevated pressures and active corrosives. To withstand these conditions, Spirotallic Gaskets employ a variety of corrosion-resistant alloys.

Because so many of these metals look alike, only expensive tests or costly experience with the gasket could determine the gasket metal used, once its identifying tag was lost. Now the color patch on the centering guide tells the metal employed and saves time, trouble and expense. This new method of identification also makes it easier for storekeepers and mechanics who handle the gasket. In addition, it simplifies inventories.

Spirotallic Gaskets hold their seal because they are made of spirally wound interlocking plies of asbestos and spring-like metal strip. These gaskets compress easily with light bolting. For catalog PK-35A and copy of color code card write Johns-Manville, Box 60, New York 16, N. Y. In Canada, Port Credit, Ont.

Here are seven of the metals available and their color identifications

Zinc-coated steel—white

Type 304 Stainless—yellow

Type 316 Stainless—green

Type 347 Stainless—blue

Monel—orange

Copper—brown

Aluminum—aluminum

JM PRODUCTS

Johns-Manville SPIROTALLIC GASKETS

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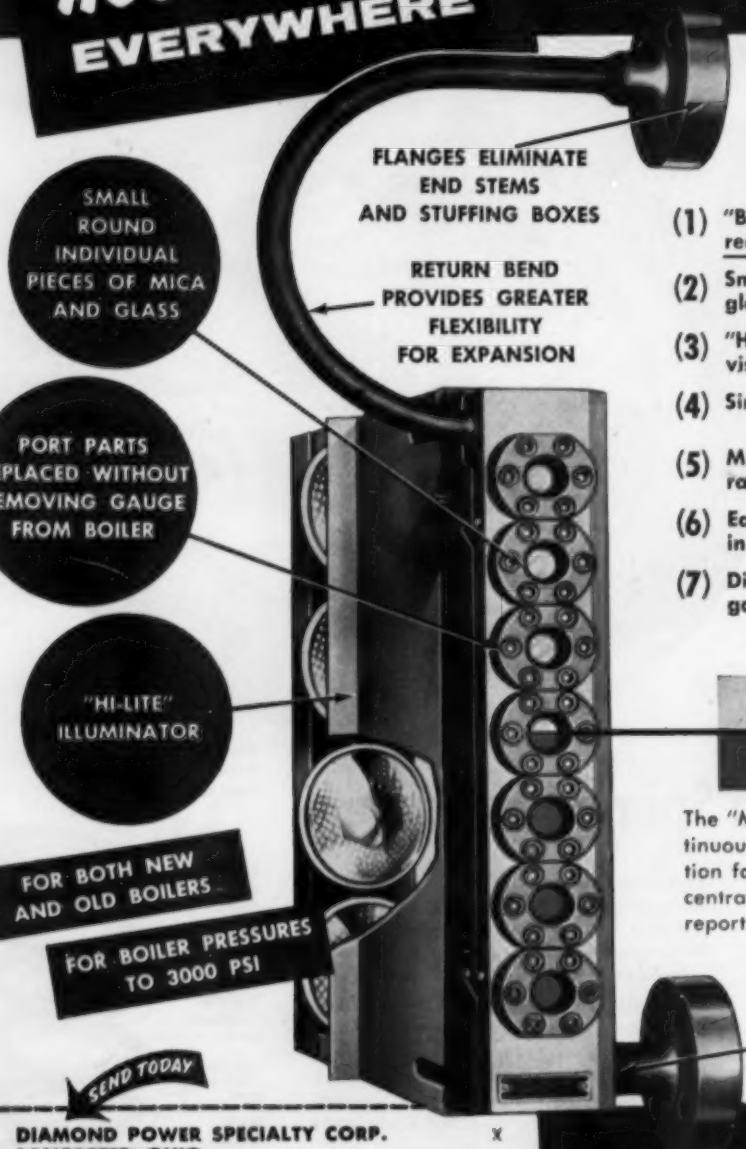
EARNING
WIDE
ACCEPTANCE
EVERYWHERE

DIAMOND "MULTI-PORT" Bi-Color Gauge


FLANGES ELIMINATE END STEMS AND STUFFING BOXES
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"MULTI-PORT" Advantages:

(1) "Bi-Color" principle shows steam red and water green

(2) Small round ports instead of long glass strips

(3) "Hi-Lite" Illuminator for improved visibility

(4) Simplified high-pressure construction

(5) Maximum thermal stability for rapid starting

(6) Easy, inexpensive maintenance . . . in place

(7) Direct reading . . . basic reference gauge

The "Multi-Port" gauge has been in continuous successful high pressure operation for more than two years in leading central station plants. Users everywhere report excellent readability and substantial savings in gauge maintenance costs. For additional information, write for Bulletin 1174.

7211

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Please send me without obligation a copy of new Bulletin No. 1174 explaining the advantages of the Diamond "MULTI-PORT" Bi-Color Gauge.

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COMPANY_____

ADDRESS_____

DIAMOND POWER SPECIALTY CORP.
LANCASTER, OHIO
Diamond Specialty Limited—Windsor, Ontario

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ideas in action

. . . starts on page 26

more troublesome, there may be enough electricity generated to knock the bulb out of your hand, so it is recommended that the bulb be attached to the end of some holder, such as a pencil. Hazardous conditions may warrant installation of specially designed static-free V-belts.

Safety unit loafs till needed, suffers no wear while waiting

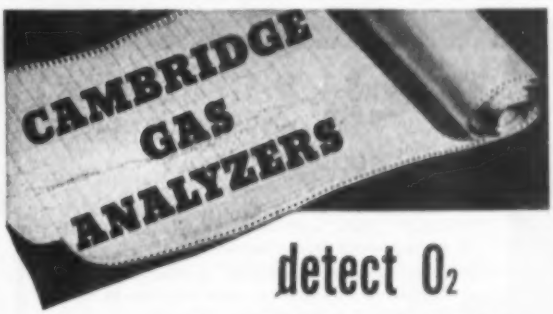
Valve that offers greatly increased safety for operators of metalworking presses with air-operated clutches or brakes has been announced by the Clark Controller Company. The Type PV valve combines an operating unit with a standby safety unit that functions to stop the press only if the operating unit fails. Only the operating unit moves with each stroke of the press. The safety unit stands by, ready to function only if the operating unit fails. Then the safety unit immediately acts to cut off air pressure to the clutch and brake. This feature saves wear and tear on the safety unit and the possibility of simultaneous failure is virtually eliminated.

A second feature of the new valve is that when the safety unit does operate, it locks in its operated position and cannot be reset until the fault that caused the action is corrected. No special device is required for reset. The valve is completely stable. The safety unit is not subject to operation due to transient or minor conditions. However, a pressure leakage approaching that necessary to keep the clutch engaged will positively and quickly cause the safety unit to function. The 1¼-inch pilot-operated valve is designed to operate at any pressure between 25 and 100 psi. It is normally furnished with 110-volt electromagnets, but can also be supplied with coils for other supply voltages.

coming events

. . . for industry & power

Sept. 26-30	Atomic Industrial Trade Fair	Sheraton-Park Hotel Washington, D. C.
Sept. 27-29	Electrical Progress Show	Convention Hall Philadelphia
Oct. 3-7	AIEE Fall General Meeting	Morrison Hotel Chicago
Oct. 10-12	American Society of Lubrication Engineers Lubrication Conference	Antlers Hotel Indianapolis
Oct. 12-15	Eighth National Chemical Exposition	Coliseum Chicago
Oct. 19-20	ASME Joint Fuels Conference	Neil House Columbus, Ohio
Nov. 13-18	ASME Annual Meeting	Congress Hotel Chicago
Nov. 14-18	Exposition of Power and Mechanical Engineering	Coliseum Chicago
Nov. 14-17	Second International Automation Exposition and Exhibition	Navy Pier Chicago
Nov. 27-30	American Institute of Chemical Engineers Regular Annual Meeting	Statler Hotel Detroit
Nov. 28-Dec. 1	Air Conditioning and Refrigeration Exposition.	Auditorium Atlantic City



detect O_2
in FEED WATER

Continuous records of the oxygen dissolved in boiler feed water and of the hydrogen entrained in steam, indicate when corrective measures are necessary to prevent otherwise unsuspected and costly corrosion. Cambridge Analyzers measure and record dissolved oxygen directly. The hydrogen in the steam is measured and indicates the quantity of oxygen set free by dissociation. Cambridge Instruments are available for continuously recording either O_2 or H_2 separately, or O_2 and H_2 simultaneously.

Send for Bulletin 148 B. P.

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INSTRUMENT CO., INC.
3060 Grand Central Terminal, New York 17, N. Y.
Pioneer Manufacturers of Precision Instruments

Circle 152 on READ-N-CIRCLE card

our readers write

. . . to industry & power

Tearsheets always available

Gentlemen:

A very interesting article entitled "Get the Most Out of Maintenance Painting" appeared in the July issue of INDUSTRY & POWER magazine. It does not, however, appear on the reprint list. If it is possible to get a reprint of this article, I would appreciate very much your sending a copy to my attention.

C. W. Hobbs
Maintenance Department
Andrew Jergens Company
Cincinnati, Ohio

● *Copies of feature articles appearing in* INDUSTRY & POWER *are made available in two forms: tearsheets and reprints. A limited number of tearsheets is always available for every I&P article whether or not special reprints are made.*

Your maintenance painting

Gentlemen:

Reference is made to your July 1955 issue which contains an article entitled "Your Maintenance Painting." In the article the author has used for his reference *Steel Structures Painting Manual, Volume 1, Good Painting Practice* and *Volume 2, Systems and Specifications.* Will you please quote price for these two volumes?

C. T. Eyring
Assistant Chief Engineer
Salt River Project
Phoenix, Arizona

● *Each volume sells for $6.00 per copy. They can be ordered directly from Steel Structures Painting Council, 4400 Fifth Avenue, Pittsburgh 13, Pa.*

Source of waste data

Gentlemen:

Referring to page 62 of your July issue, kindly advise where I can secure papers from Proceedings of Ninth Industrial Waste Conference held at Purdue University.

Edson L. Barlow
Belding Heminway Company
Putnam, Conn.

● *Proceedings of the Ninth Industrial Waste Conference can be obtained from the University editor, Purdue Uni-*

Pick INSTANTANEOUS HOT WATER HEATERS
ENGINEERED FOR SERVICE
Industries everywhere are replacing outmoded water heaters with Pick Instantaneous Water Heaters. Here are the reasons:
★ Water Is Heated Instantly. Entirely automatic, Pick Heaters operate by steam injection to heat the water in a flash to exact temperature desired and in volume required.
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Write for booklet on how PICK HEATERS cut costs of Hot Water — No Obligation. Write IP-555
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versity, Lafayette, Indiana. Ask for Extension Series No. 87, Engineering Extension Department.

Steam on wheels

Gentlemen:

In your June issue of INDUSTRY & POWER on page 26 under Steam on Wheels, we'd like to know where we could get more additional information on this?

I am convinced that any type of service such as they have here is readily accepted by the public.

I'm very interested in this steam generation, and if you can get me any information as to where I can obtain more detail data on this I would appreciate it.

George W. Sayer
Berry Ervin Engineering Company
Minneapolis, Minn.

● *More information on "Steam on Wheels" can be obtained through Franklin Associates, 2022 South Mesa Street, San Pedro, California.*

Refresher keeps rolling along

Gentlemen:

I should very much like to receive Part I and Part II or, better yet, a bound copy, of all parts of Professor Lee's article appearing in your magazine, entitled "A Thermodynamics Refresher."

H. A. Kammer
Executive Vice President
Engineering, Construction and Purchasing
American Gas and Electric Service Corporation
New York, New York

Gentlemen:

I have just finished reading the very worthwhile article — A Thermodynamics Refresher II—in the June 1955 issue of INDUSTRY & POWER, and find I have somehow missed the first installment. I would very much appreciate the receipt of a single copy of the first installment.

Robert R. Bregi
Engineering Department
Atlas Brewing Company
Chicago, Illinois

Gentlemen:

We read with interest your article "A Thermodynamics Refresher," chapter one. We would very much appreciate it if we could have the complete series of this refresher course for our files, when it is completed in the magazine. Several of our men have expressed an interest in "catching up" on this subject.

Freeman Felt
Electrical Engineer
Rayonier Incorporated
Shelton, Washington

Gentlemen:

In the May 1955 issue of INDUSTRY & POWER magazine .... there is the first of a series of articles on the Thermodynamics Refresher. Would you be kind enough to send two copies each month of these articles for the duration of the series.

P. M. Matthews
Manager of Manufacturing
Feeder & Service Division
Westinghouse Electric Corporation
East Pittsburgh, Pennsylvania

● *Single copies of the Refresher articles are sent free upon request. For quantity prices on reprints, see "available reprints" on page 98.*

Profit Two Ways With...
WILSON Condenser Tube Inserts

1 Put Equipment Back on Line Faster

You save man-hours and money with new Wilson Condenser Tube Inserts because they eliminate the need to plug off leaking condenser or heat exchanger tubes. Wilson Inserts go in fast...need no cementing... take less time than it does to plug a "bad tube". What's more, these highly efficient inserts put the tube back into operation as in the original design.

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In many cases, condenser tubes usually fail within the first few inches of the inlet. Wilson Condenser Tube Inserts actually restore these leaking tubes to service by sealing the deteriorated portion of the tube. Wilson Inserts also retard or eliminate the effect of inlet end erosion.

Send for Bulletin 500 which gives the full story on time-saving, money-saving Wilson Condenser Tube Inserts.

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Depend on these powerful, fast-acting cleaners to do a thorough job every time. There's a Wilson cleaner for all types of tube or pipe. All sizes in stock for immediate delivery.

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For re-rolling old tubes or installing new ones. Precision-made to insure firm seating. Self-feeding and parallel expansion for a particular trade.

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Circle 134 on READ-N-CIRCLE card

spot news

. . . . about industry & power

• Richardson goes abroad

Richardson Scale Company is opening a new European headquarters at Geneva, Switzerland. Sales, consultation, installation, and maintenance services will be offered to the European market for the company's line of automatic machinery for weighing and proportioning. Licensing arrangements will be made with European manufacturers for the manufacture of certain metric unit scales from basic Richardson designs and specifications.

• Largest industrial intercity telephone network goes into operation

Wheeling Steel Corporation has just put into operation a new dial telephone system that interconnects eleven plants on the Ohio and West Virginia sides of the Ohio River. By means of an enlarged network of 54 intercity tie lines, employees of the firm will be able to dial their own calls straight through to any telephone at any one of the corporation's plants. The system is a joint undertaking of the Chesapeake and Potomac Telephone Company and the Ohio Bell Telephone Company. It comprises 77 central office trunks, 50 tie lines, and 4000 telephones.

• Your electricity costs more

Average bill for an industrial plant with a 1000-kw demand and using 200,000 kwh per month was $3168 on January 1, 1955, according to the Federal Power Commission. FPC reports that the bill for the same amount of energy on January 1, 1954 was $3162, in 1941 was $2814, in 1940 was $2828, and in 1935 was $3081.

• Engineers' salaries up 4.5 percent over 1954

American Management Association has just completed a survey showing that engineers and other professional employees in American industry now are earning about 4.5 percent more than they earned last year. Twenty engineering and professional job categories in 19 industries were covered. The survey showed that the average beginning engineer receives about $4500 per year. Median pay for electrical and mechanical engineers is $7000. "Middle management" personnel (those between the first-line supervision and the policy-making level) tend to receive similar salaries regardless of geographic location, industry classifications, or company size.

• Technical painting analysis service launched

Glidden Company is launching a new cost-free service to reduce losses from improper maintenance painting. The service is aimed at curtailing costly maintenance, improving protection, correcting conditions that lower employee efficiency or that are safety hazards, and to reduce overall operating expenses in general. The service is expected to be of particular value where corrosion problems involving machinery, areas exposed to fumes or moisture, structural framework, and pipes conducting liquids and gases are involved.

• Last-half business looks good

Business in the remainder of 1955 will be just as good as it was during the record first half, if not better, according to 131 companies surveyed by the National Industrial Conference Board. More than half of the companies reporting anticipate higher production rates. Over three-quarters of those responding expect pretax earnings for the calendar year 1955 to top the 1954 calendar year.

• Barker to be next ASME president

Joseph W. Barker, chairman and president of the Research Corporation, New York City, will be next president of ASME. He will take office at ASME's annual meeting in Chicago this fall. Four regional vice presidents will also take office: Charles E. Crede, vice president and chief engineer of Barry Controls; Frank W. Miller, vice president of Yarnall-Waring Company; Albert C. Pasini, general superintendent of production for The Detroit Edison Company; and Bryan T. McMinn, professor of mechanical engineering at University of Washington, Seattle.

• Reynolds to dig and burn own coal

Reynolds Metals Company will build a 300,000-kw power plant that will burn coal mined from adjacent company-owned deposits as part of a $230 000 000 facilities expansion program aimed at increasing its total primary-aluminum-producing capacity by 270,000,000 pounds.

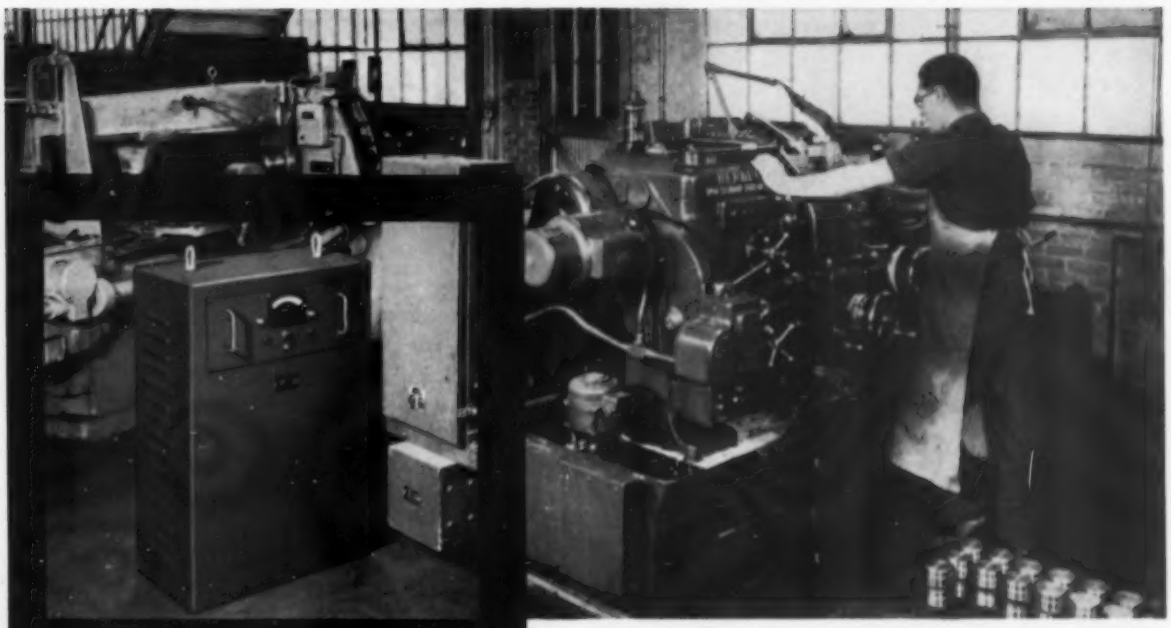
Over 1,000,000 tons of coal a year will be required at the new power plant. The 2,000,000-pound primary production plant in the Ohio River Valley marks the emergence of coal as a major source of electricity for aluminum production.

• Anaconda expands aluminum wire production

Anaconda Wire & Cable Company has started production of aluminum wire and cable in a new building in Sycamore, Illinois. The new building will quadruple the output of bare, rubber-insulated, and synthetic-insulated aluminum wire and cable at Sycamore. The company has other aluminum facilities in Montana, New York, Indiana, and California.

• Eaton completes $3,000,000 move

Eaton Manufacturing Company moved its entire stamping division through 38 city blocks in Cleveland — one of that city's biggest moving projects. Production capacity will be increased 40 percent as a result of the move. The remodeling and moving project cost more than $3,000,000.



Prevent V.V.T.* with

* *Varying Voltage Troubles that cause Production "Bugs", Rejects, Burned-Out Motors and Lamps*

STABILINE AUTOMATIC VOLTAGE REGULATORS

This is a picture of a STABILINE type EM preventing voltage variations that can result in burned-out motors and work spoilage on the production floor. In the inspection department V.V.T. can put inspection gear out of calibration, get okays for sub-standard work.

Don't be satisfied with the "allowable" voltage variations of your power! It can cause you trouble without your ever knowing the cause. Progressive production men today demand the constant voltage maintained by a STABILINE Automatic Voltage Regulator. Send coupon for full details.

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THE SUPERIOR ELECTRIC COMPANY
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Please send my copy of the STABILINE Bulletin

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Position .....

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Company Address .....

City ..... *Zone* ... *State* .....

Circle 112 on READ-N-CIRCLE card for more data

ANOTHER KEWANEE-SPRINGFIELD "PACKAGE" WITH YARWAY BLOW-OFF VALVES

Kewanee-Springfield . . . a good name in package boilers, furnishes *Yarway* . . . a good name in blow-off valves, for dependable blow-down service on their popular boiler line.

It's a good idea . . . used by more and more boiler manufacturers, and appreciated by their customers. Already more than 15,000 boiler plants use Yarway Blow-Off Valves. There must be good reasons . . . *there are.* Yarway Blow-Off Valve Bulletin B-426 explains these reasons. Write for a free copy.

Be sure to specify Yarway Blow-Off Valves when you purchase *your* package boilers.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
Branch Offices in Principal Cities

Yarway Type "8" Seatless Tandem Blow-Off Valve. Note balanced sliding plunger design with no seat to score, wear, clog or leak. Pressures to 400 psi.

YARWAY BLOW-OFF VALVES

Circle 107 on READ-N-CIRCLE card for more data

How soon will nuclear reactors be ready for your industrial powerplant? What obstacles will have to be conquered? What kind of operating techniques and system response can you expect? Here are the answers from an expert who has lived in the midst of nuclear power development from its beginnings, who has testified before Congressional committees shaping atomic law, who will be among those present in the breakthrough of economic nuclear power.

I&P EXCLUSIVE

Are you thinking yet about....

NUCLEAR power for YOUR plant

DR. KARL P. COHEN

Vice President

Walter Kidde Nuclear Laboratories, Inc.

(as told to Harold A. Bergen, Editor)

Dr. Karl Paley Cohen is one of the pioneers in the early scientific work that ultimately led to the Manhattan District Project and the atomic bomb. He was assistant to Dr. Harold C. Urey from 1938 to 1940. He was later made director of the Theoretical division of Columbia University's Manhattan Project Laboratory. He has worked in atomic energy for Standard Oil and as consultant to General Electric and the Atomic Energy Commission. Dr. Cohen has testified before Congressional committees shaping atomic energy legislation. He served as technical advisor in the United States delegation to the United Nations International Conference on Peaceful Uses of Atomic Energy, concluded last month in Geneva, Switzerland.

NUCLEAR POWER plants in sizes and capacities for the industrial powerhouse may be economically competitive with fossil-fuel plants by 1958. We are now thinking in terms of the economic breakthrough coming in about three more years. Right now, we would need very special circumstances to come up with an economically justifiable nuclear power station in sizes for industrial plants. But within five years, certainly, circumstances will not need to be so special for such a plant to exist.

I am a small reactor man. The kind of reactor plants I refer to here—that would fit the needs of an industrial plant—span a range whose bottom limit is about 15,000 kw. Top limit would be 75,000 kw, or perhaps 100,000 kw.

There is a definite (though somewhat limited in terms of units) market for nuclear powerplants larger than this "industrial" range. These are the plants in the large "public utility" range, where large chunks of generating capacity can be put into one basket. Work on these larger reactors is quite naturally going forward faster than on the smaller "industrial" reactor powerplants for two reasons. First, the utilities are fundamentally in the business of producing power, whereas industrial plants that produce their own power produce it only as a means to a further end.

Utilities, therefore, have legitimate concern with future fuel sources. Development of fuels for the future can be properly written into their general rate structures as research and development costs.

This is in the public interest, and the public pays. I think this is quite sound—as sound as any research and development expense

might be for any business. But the industrial plant, not being in the business of producing power as such, cannot justify research and development costs for fuel sources.

Physics favors large reactors

The second factor favoring more rapid advancement of the "utility" size reactor is that the physics of nuclear power reactors gives certain advantages to large units that will permit them to attain an economic breakthrough first. Let me point out now, though, that all this is not to say that research in behalf of small reactor plants is not being carried forward. The Army's Package Reactor is currently being developed, though on the strength of more extraordinary requirements—chiefly logistics—than would be presented by industry. We can hope that experience with logistically advantageous nuclear power plants, or with other special plants (such as propulsion powerplants for submarines, aircraft, or locomotives), will contribute to understandings of nuclear power generation that will apply to industrial powerplants.

Our firm has already talked to paper mills and mining companies, among others, in search of conditions that would establish the basis for the first economic breakthrough. Of course, any industrial plant must first consider the basic problem of in-plant generation versus purchased power. Process steam requirements can be lumped in with power requirements. But "nuclear" steam is no better than "conventional" steam.

Occasionally, there are industrial wastes which must be disposed of by burning. These make severe competition. In talks with paper mills, for example, we find that nuclear fuels must compete with free pulp-mill wastes currently being used as fuels.

Special difficulties in small plants

We meet some special difficulties in developing the small reactor plants. These include:

¶ The plants are experimental in the sense that we haven't had experience enough to say that a plant quoted at $10 million would not ultimately cost $12 million.

¶ Reactor plants do not have a history of operating experience comparable to that of the conventional, fossil-fuel steam plant. Industrial firms usually have but one powerhouse, whereas a large utility may have a system of many plants. So unless you are a utility (which can drown mistakes in estimates of operating costs in the financial depths of utility accounting), you find little room for cushioning mistakes in estimated operating costs. (A utility can absorb what has the effect of but a small estimating error when its 200,000-kw nuclear plant is part of a 4-million-kw system.)

¶ Money for a powerplant is more expensive to the industrial enterprise. A utility's capital is committed by the very nature of the business to investment in power-producing equipment. Capital earmarked by industry for a powerplant is competing with investment opportunities in production equipment, which ordinarily offers a quicker financial return to management. Capital for an industrial nuclear powerplant, therefore, is more dear to the industrial.

¶ The very long development program in nuclear fuels that is vital to the economic success of nuclear power currently operates against early emergence of an economic industrial-size plant. All that a prudent industrial nuclear powerplant designer can do is design on the basis of what he knows can be done today, not on what he can hope to do tomorrow. (I think, for example, that fuel elements will last indefinitely, but I could not ask you to put your money on it.) To invest industry's dollars on the basis of hoped-for solutions would demand an unusual benefit in return for the risk. For an industrial, this benefit does not yet exist.

¶ All reactors (not only the small ones) face an obscured fuel supply and fuel price picture. The current government price schedule will expire three or four years after plants now under construction will be up. Congress has set a limit of seven years on AEC price schedules. The effects of the stockpiling program on raw materials and processed fuel materials can fluctuate widely

"You can make a case for anything if you want to be optimistic. . . ."

"We are trying to find something economic on the first round of design. . . ."

as the international situation varies in the next few years.

Now, then, until power use of fissionable material is comparable to military use, there can be no stabilized picture. It will be quite some time before such stabilization comes about. I don't know exactly what that time might be, but my guess is 20 years. This guess would vary, depending upon two factors: (a) how fast military needs expand or decline, and (b) how fast private power development expands or declines.

Industrials, be conservative

These then are some of the reasons why we must be prudent in forecasting the use of nuclear power reactors in industrial powerhouses.

Those firms whose business is the manufacture of the principal equipment for power generation must be optimistic in viewing the nuclear power picture. This perhaps accounts for the calculated-to-be-encouraging statements coming from the high echelons of our major power equipment manufacturers. But other companies, that don't have big investments committed to leadership in the power field, must be more conservative. And for the industrial plant that is considering power generation to support its production of other goods, restraint in nuclear power is even more advisable. The average industrial is not entitled to take the risks in power development that the power industry, as such, can take.

How then will the first small reactor be developed for industry? First, let me say that I'm sure we're going to solve all the problems—economic and technological. Ultimately, reactor plant prices will come down and reactor fuel efficiencies will go up. Nuclear reactor powerplants are presently characterized by high capital cost. Wearing our rose-tinted glasses, we see that we will get those high capital costs way down—not in five years, but certainly in 20. But long before that, within the next three to five years, the cost-per-kw delivered by an industrial-size reactor plant should break through the economically competitive barrier. Nuclear fuel, for example, should begin to show up favorably in areas where coal costs more than $7.50 per ton.

Undoubtedly, the second round of design will be better than the first. We are trying, of course, to find something in the first round of design that will be more economical than the fossil fuels.

What will happen?

What will happen is that we will quote a given-size plant for, say, $10 million when we really think we can build it for $10 million. We would then be prepared to take the risk that it might cost $12 million.

Actually, we are now approaching the stage of proposing a 75,000-kw reactor plant in competition with a fossil-fuel plant. Steam from this plant would be sold by the industrial to a local utility.

To give you further appreciation of the financial magnitudes to be considered, we would say now that the reactor-steam part of a 37,500-kw nuclear powerplant might cost $5 million, exclusive of rotating equipment and switchgear. A 75,000-kw plant, on the same basis, would cost some $8 million. The fact is that the cost-per-kw curve is much steeper for the nuclear plant than it is for the fossil-fuel plant. That is, the economic advantage of bigness is far more pronounced at the present time in nuclear plants than it is in the fossil-fuel plants.

These of course are not the total investments. You still need to account for land, working capital, and financial charges. These might add another $2 million to the plants quoted above. So the 37,500-kw plant might cost $7 million on the hoof, and a 75,000-kw plant might cost $10 million on the hoof—assuming you want to include for comparison some of these fixed charges applicable to both.

Operating procedures

In matters of operating procedures, the nuclear plants will be designed with great care. When the major operating hazards have been licked, we will have licked the minor nuisances in the process. What we will finally come up with is a more controllable, a

"Economic advantage of bigness is far more pronounced in nuclear plants...."

"Chain reaction is more controllable than combustion. . . ."

"Everything is going to happen faster . . . . than I predict."

more stable, and a more reliable generating plant. Nuclear powerplants will require much less maintenance than conventional fossil-fuel plants.

Fission more controllable

The nuclear chain reaction is very much more controllable than the combustion reaction common to today's steam plants. It takes more sophisticated equipment to control a chain reaction, but the operating process is much easier. For example, it is very difficult to quickly double the flow of oxygen and pulverized coal in a boiler. Doubling the rate of the nuclear reaction is quite easily accomplished—almost push-button fashion. The reactor itself is much smaller than the conventional boiler, so there is less systemic inertia.

The secondary steam cycle is the same in both cases. But the primary cycle, where combustion gases are replaced by less bulky fluids, effects further advantage in controllability. Heat transfer from conventional combustion gases to the boiler water requires a good deal of heat exchange surface. This is not true in liquid-to-liquid reactor heat exchange. (Here, too, the advantages of the nuclear reactor plant become most significant in the larger plant.) And, there is no fly ash problem or exhaust corrosion problem in a nuclear plant.

Getting down to specific reactor types, I'm inclined to believe that the first economic nuclear power plant will use the Pressurized Water Reactor. It suffers the least in going to smaller sizes. (This, incidentally, is the type being used in the Shippingport, Pennsylvania plant being built for Duquesne Light.) Even over the long haul, it looks to me as if the Pressurized Water Reactor will be "it" for the smaller plant. The other types currently under study are more apt to be interesting to the large utility-size generating plants.

Utility progress will help

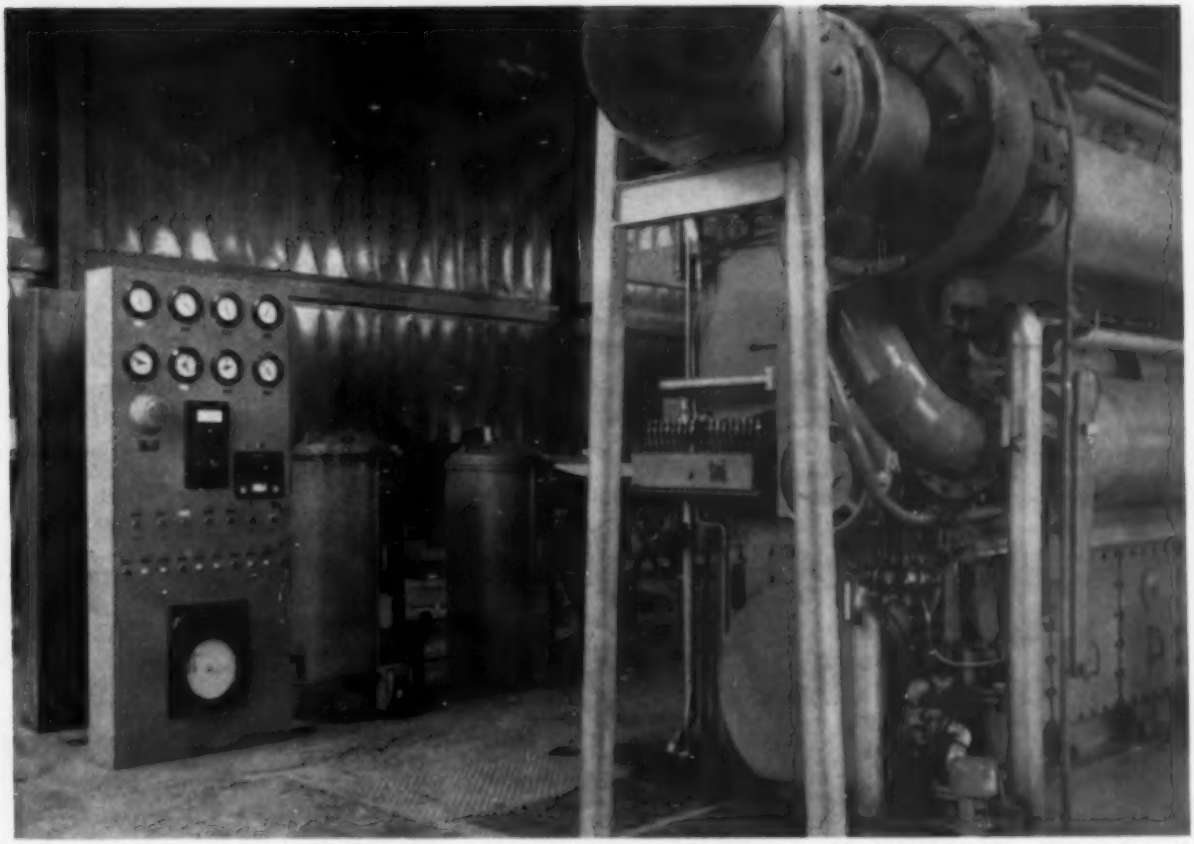
Progress on the utility front, of course, will help accelerate the economic breakthrough for the industrial nuclear powerplant. Certain problems initially met when the first large utility reactors go on the line will demand solutions of problems that will ultimately face the small plant. Chemical handling and waste processing techniques peculiar to nuclear powerplants, for example, have not been organized on an industrial basis yet. There are no facilities except government facilities. There are only government prices and these have not yet been posted. We are not yet exactly clear on what the government will do in these realms. Carbon copies of solutions to such large-plant problems certainly will not be valid for small plants, but the lessons thus learned will undoubtedly help.

These are birth pains

These are the birth pains of nuclear power for industrial plants. Of course, you can make a case for anything if you want to be optimistic—or against anything if you want to be pessimistic. I have no doubt whatever that nuclear power will be competitive for plants of 100,000 kw or more. I am hopeful that it will be competitive in sizes down to 35,000 kw. I am pessimistic below that size.

These feelings of mine all depend on the time scale over which we wish to project. Nuclear fuel costs, for example, could change enough over a long period of time to alter these guesses. I can think of a factor that would effect an immediate change: the international situation could shift so as to devalue our stockpiles and thereby help the nuclear fuel cost picture.

Perhaps I should conclude by telling you of my sincere conviction that everything is going to happen faster and better than I predict here.



Cylinder lubricator is mounted below and to left of turbocharger. Movable steel wall is behind lube purifier and panel.

How *DUAL-FUEL diesels* help a utility

A small city utility gets flexible power supply at lower cost than purchased power. Its plant points the way for industry.

RAY HALL
Chief Engineer, Nebraska City Utilities
Nebraska City, Nebraska

I&P EXCLUSIVE

WHAT TO DO when you inherit a run-down, inefficient generating plant — that was the problem confronting us in 1945. When Nebraska City purchased the electric utility system from Consumers' Public Power District in 1945, it took over an inadequate power supply with poor voltage regulation and heavy transmission losses. But smart long-term planning by the city's board of public works has brought the utility up-to-date with a modern generating facility that is keeping pace with increasing loads, and supplying cheap electricity to the community.

Electricity is supplied to a city of about 8000 inhabitants, plus about 14 small towns and some 450 farms in the surrounding district. The city has four medium-sized industries and a dozen small ones.

The powerhouse, at the time of purchase, generated 2500 kw and had a 2000-kw connection to the Power District's 33-kv transmission line. Three 480-hp Heine, two-drum, straight water-tube oil- and gas-fired boilers generated 165-psi steam. They were connected to one 1250-kw, one 750-kw, and one 500-kw turbo-generators. The 500-kw unit was built in 1909. It had been retired before World War II, but was later rehabilitated and is still in use. The other two turbines (one new in 1915 and the other in 1923) were in poor shape due to age and lack of maintenance. Efficiency of the entire plant was low because of the poor state of repair and the low steam pressures used. The heat rate was running about 33,000 Btu per kwh.

Load climbed steadily after World War II. In 1950, long-range plans for an improved power source and distribution system to

be built over the next 15 years were made. To decide on the most economical source, four possibilities were investigated thoroughly:

¶ Purchase all the power from the Power District;
¶ Seek any other available source;
¶ Expand the capacity of the old steam plant; or
¶ Build a new diesel plant.

To purchase enough additional power from the Power District, a new 69-kv line and three city substations would have to be built. The rate charged Nebraska City would be that in effect for wholesale energy supply to municipalities. It would be cheaper for the city to generate its own power.

To purchase power from any other source would require renegotiation of the contract with the Power District. The contract does not expire until 1965. It specifies that the city guarantee a minimum 700-kw demand each month from the Power District.

Expansion of the city's steam plant capacity would require a modern high-pressure boiler and turbine to obtain good efficiency. But the unit would have to operate at far below full capacity, or as standby, for several years because of the minimum purchase contract clause. Such operating conditions for steam equipment would not be profitable.

Diesel flexibility decides

Flexibility of diesel electric generating units and their favorable efficiency at full or part load decided the issue. Load curves indicated that a total of about 10,000-kw capacity would be needed in the next 15-year period. Peak load had increased from 1955 kw in 1940 to 4550 kw in 1952.

It was decided that the first diesel unit should be about 1400 kw. With limited space available and a danger of flooding at the old steam plant, we decided to build on higher ground at a new location about 500 yards away. The old plant should be retired in the next 10 to 15 years.

An extensive cost analysis of all power sources indicated that the most economical procedure would be to carry on operating with the existing steam plant, purchase minimum power from the Power District, and install new dual-fuel diesel units as the load increased. Based on the 1950-51 conditions, the savings from this combination were estimated at $38,000 a year.

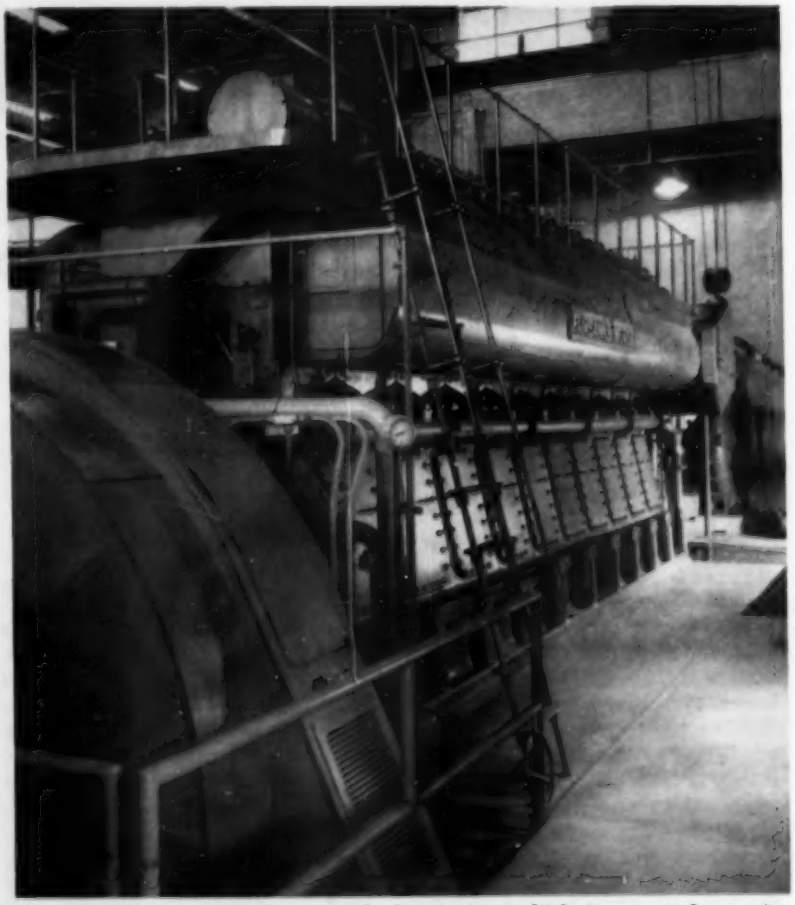
We decided to build the new diesel generating plant in three sections, each section large enough to house two engine-generator units. The building is of lightweight concrete block with a brick exterior. It has one wall of movable steel panels. This allows for expansion at minimum cost as extra units are added. The steel structure of the building takes all the weight. Lightweight concrete blocks were used for their acoustical qualities.

The first 1500-kw unit was placed in operation in 1952, and the second in 1953. Both of these units are 2120-hp four-cycle, eight-cylinder, 16-inch bore by 22-inch stroke, 327 rpm Nordberg Supairthermal Duafuel engines. They are direct connected to 1500-kw, 4160-volt, 60-cps generators.

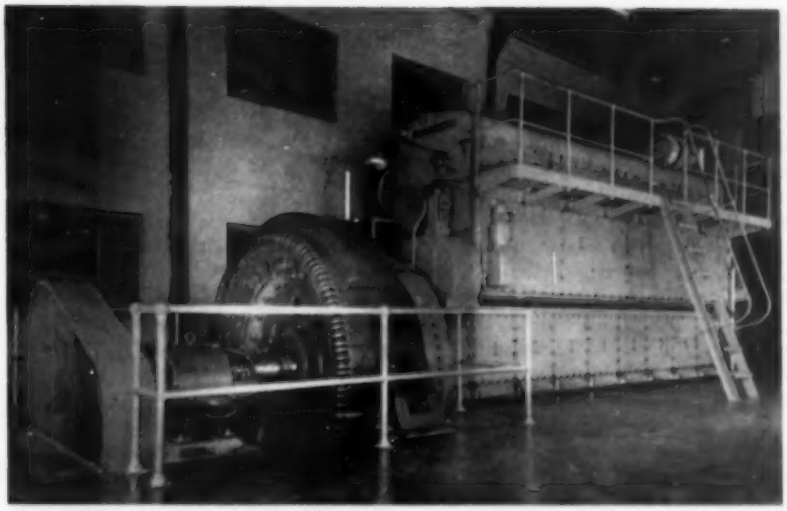
Cheap natural gas is burned as main fuel with about 5 percent pilot fuel oil. This year, a third diesel unit is being added to keep pace with increasing load requirements. This third unit is a ten-cylinder, 18-inch bore by 27-inch stroke, 3500-hp dual fuel Fairbanks-Morse engine. It is direct connected to a 2500-kw Fairbanks-Morse generator.

Mount on unusual foundation

The Fairbanks-Morse engine is mounted on an unusual foundation. Reinforced concrete foundation extends through the basement to a 2½-foot-thick spread footing that projects 2½ feet beyond the sides of the foundation. The main foundation is 13½-feet wide by 41-feet long. From the engine end, a tunnel 6½-feet wide by 7-feet high



Newest addition is 3500-hp ten-cylinder engine, which is mounted on reinforced-concrete foundation with internal tunnel to protect against resonance.



Structural steel takes weight of building and lightweight concrete blocks reduce reflected noise. The original two units are producing 1 kw on 10,000 Btu of fuel.

with its floor at basement floor level extends 25 feet into the foundation along the centerline. This design reduced loads upon the soil, equalized bearing loads at all points on the supporting soil, and favorably changed the natural frequency of mass, thus protecting against resonance. The foundation has shown exceptional stability under operating conditions.

No. 2 fuel oil is stored in 60,000-gallon underground storage tanks after unloading from trucks. It is then pumped via fuel filters to individual day tanks located in the basement. Natural gas is supplied at 150 psi from a three-inch main connected to the Natural Gas Pipeline Company of America's mains 23 miles to the north. Gas passes through two regulators, reducing pressure to 42 psi and 34 psi, to avoid any possibility of high-pressure gas getting to the engines.

Start on fuel oil

Fuel oil is used only to trigger combustion of natural gas. Engines are manually switched over to natural gas for economy reasons. In the event of gas failure, the engines automatically switch over to fuel oil operation. Before and after shutdown, the engines run for five minutes on full diesel to clean residual gas from the system.

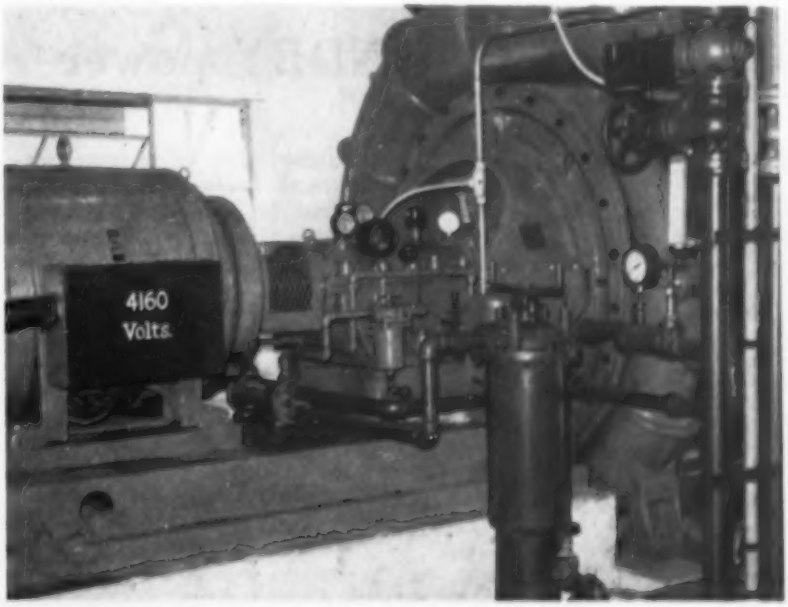
Straight mineral oil (30 SAE) for the two Nordberg engines is filtered through Honan-Crane filters with Fullers Earth media. Detergent 40 SAE oil is used on the Fairbanks-Morse engine after filtration through similar filters with cellulose media. Crankcase oil circulates continuously through the filters, but the engines have separate lubrication systems. Two Worthington air compressors supply compressed air for starting. One is equipped with a Wisconsin 20-hp gasoline engine for standby use in the event of power failure. The two-stage compressors are both driven by 15-hp electric motors.

Air for the Nordberg engines passes through a Cycoil oil-bath cleaner, then goes to an exhaust-gas-driven supercharger where it is compressed to 14 psi. An intercooler then reduces the air temperature before it enters the engine cylinders so that more air can be packed into the cylinders than with conventionally supercharged engines. This allows more fuel to burn, and increases power output without increasing combustion temperatures or pressures. The intercooler also allows the engine to maintain maximum load even during summer when air temperatures are high.

The Fairbanks-Morse engine has a Roots Connersville blower driven by a 300-hp electric motor. The air passes through an Alton Aqua-sprae precooler and then through a Continental air filter before going through the intercooler.

No silencers have been installed on the air intakes because of the remote location of the plant, but Maxim and Burgess-Manning exhaust silencers are on all units.

The adjacent Missouri River would have been an excellent source of cooling water if it were



Roots Connersville blower for Fairbanks-Morse engine has a 300-hp F-M motor. Air passes through a precooler and filter before going through intercooler.

not so prone to seasonal flooding and fluctuating turbidity. We decided to install cooling towers. Zeolite softeners, with an automatic signaling device for regeneration time, soften the jacket water as well as the spray water. The water then circulates through a closed cycle, and is cooled in a heat exchanger by water from the cooling towers. The cooling-tower water also circulates through the intercoolers and the lube oil coolers.

Automatic controls keep the required amount of water flowing through the shell and tube-type heat exchangers to maintain proper oil and engine temperatures. This closed circuit cooling system was decided upon in order to eliminate the possibility of freezing of the cooling-tower coils if one of the three towers had to be shut down in the winter.

Brine storage pays

At the rear of the plant, a concrete brine tank has been installed to receive bulk salt (delivered by truck) and to store brine for regeneration of the Zeolite water softeners. The bottom of the tank has a sand and gravel filter. Brine is drawn off as required. It is estimated that the difference in cost between bulk and sacked salt will pay for the cost of the tank in two years time, if water consumption stays at its present level of 360,000 gallons per month.

The cooling tower make-up water is softened with a sodium Zeolite softener. It is given additional treatment to remove algae and prevent delignification of the cooling tower wood. Two of the towers are single cell, and the third is a two-cell, induced draft type.

The diesel plant employs four men and the steam plant employs eight men. A chief engineer divides his time between the two units.

Electric power from the generators is delivered through unitized metal-clad switchgear to the existing distribution system. Plant auxiliaries and lights are handled by three 25-kva 4160/120-240 volt transformers, and one 300-kva, 4160/480-240 volt transformer.

The 2500-kw unit has not been installed long enough to show any definite operating efficiencies. But the two original Nordberg units averaged a heat rate of 10,137 Btu per kilowatt last year. During the year, they generated 15,285,640 kwh, of which 299,300 kwh were used in the station, giving a net generation of 14,986,340 kwh. Gas usage amounted to 152,207 mcf and oil usage was 127,443 gallons. This figure includes a run of 33 days on oil alone when the gas supply was curtailed. Independent testing laboratories have determined the gas lhv as 905 Btu per cubic foot and the oil lhv as 135,810 Btu/gallon.

Switchboard costs

Switchboard cost per kwh — including labor, maintenance and complete operation — is 3.21 mills per kwh for last year. Depreciation on the equipment was 1.65 mills. Interest on the investment was 1.04 mills, making a total cost of 5.9 mills per kwh.

The city is extremely proud of its electricity generation plant. Highest peak load yet this year was 6250 kw, which, when compared with the 1955-kw peak in 1940, graphically shows the increase in electrical consumption in this area.

Provision of a good electrical supply at economical rates was a big factor in the attraction of two new industries to the area. Not only is the utility providing cheap electricity (1.5c per kwh to industry), it is managing to keep ahead of the demands of its consumers in this age of staggering increases in electrical consumption. And it is demonstrating the economy and flexibility of dual fuel diesel electric generating plants.

How to use STANDBY power

STANDBY ELECTRIC power operates critical lights and motors, eliminating the possibility of accidents during a power failure in the plant of Shwayder Brothers, Inc. in Denver, Colorado. The standby generator unit is a 90-kw Caterpiller D326 diesel electric set.

High-speed machinery would lose power during power failure, but wouldn't stop immediately. In a blackout, this presents a serious hazard. The standby generator provides 220 volts to critical motors and 127 volts to the lighting circuits. A special automatic air starting device enables the engine to provide full emergency circuit power within five seconds after a power failure. The engine is preconditioned with 60° F water circulating in the cooling system.

Failure on anyone of seven key circuits in the plant will automatically start the engine and provide power to all lights and motors on that emergency circuit.

Floodlights on the emergency circuits are strategically located throughout the plant. When power is cut off, by accident or intentionally, the lights come on immediately. In the boiler room circuit, however, the motors that drive the fuel pumps and blower have to be turned on manually. The operator is required to go to each engine and press a button so he can check that the heating plant engines are actually running.

Although only minor failures have occurred since the installation of the standby unit, the engine has been used considerably when electrical construction and maintenance have had to be carried out at night. The circuit being serviced can be shut off, and the repairmen have adequate light from the emergency circuit without using portable lighting arrangements.

The only machinery that operates off the standby generator is in the maintenance department. Repair tools and motors operating large overhead doors are wired to the standby circuits so that repair work can be completed quickly under emergency conditions requiring standby power.

Sandblasted windows present pleasing appearance and are self-cleaning. Blasting is done with special ground stone abrasive. Area shown can be blasted in three days. Good operator can eliminate drifting sand. Breakage is no problem.

For better lighting at less cost

I&P EXCLUSIVE FROST your windows

CLINTON BELKNAP
Electrical Engineer

C. T. GRUNER
Supervisor, Plant Engineering

Detroit Diesel Engine Division, General Motors Corporation

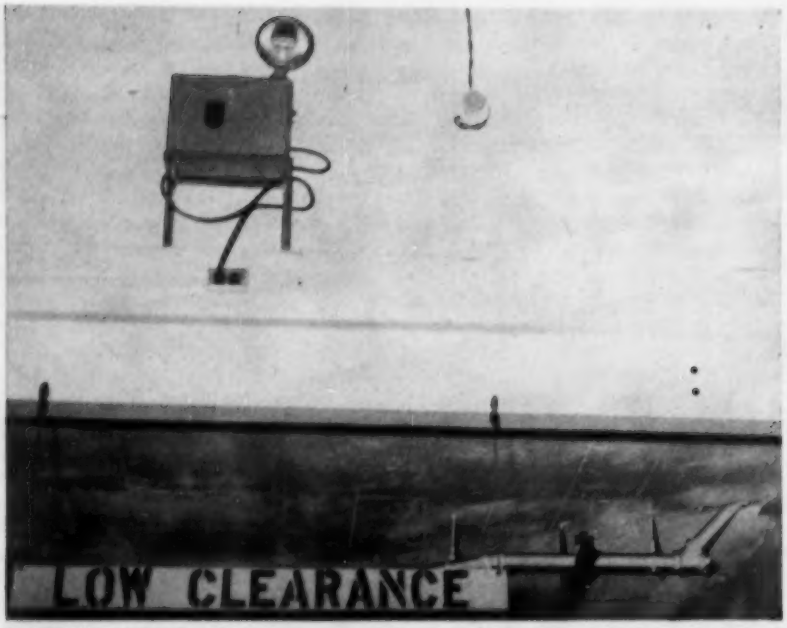
WE ARE saving $2400 a year and getting better factory lighting at the same time. How? We took the covers off of our windows and skylights, frosted them, and let the sunshine in.

When Detroit Diesel Engine Division purchased, renovated, and moved part of its manufacturing operations into another plant about five years ago, we were really happy. Even on dark winter days the manufacturing building seemed blessed with generous quantities of natural light from windows and skylights. The building contained about 130,000 square feet of floor area. All exterior walls were window glass from four feet above the floor to the roof level. The roof had approximately 32,000 square feet of monitors and skylights. This building apparently was going to be a bright, pleasant place to work.

It wasn't long however, before a few complaints were made about glare from the sun. By the time the first summer came, complaints were many and loud from people who had to work in the heat and glare of the sun's rays beating in through those windows and skylights.

The simplest solution seemed to be a coat of paint. So, a highly-recommended, special paint for glass was purchased and applied to all windows and skylights except those with a northern exposure. The complaints about the sun stopped. But then the electric lights had to be turned on, even on bright days, to provide sufficient illumination. That wasn't all. In less than two years, the paint on the glass was beginning to fade badly and come off in spots. The glass surfaces looked unsightly. More paint was needed, but first the old paint had to be removed. The cost for removing paint and repainting was going to be about 24 cents a square foot. It was estimated that this repainting would have to be done every three years.

So our extensive windows and skylights had become a nuisance,



Remotely located signal lamp reminds supervisors to turn the lights on.

and mighty costly to maintain. It was decided that there must be something better than paint to control the sun's rays coming into the plant. Different kinds of glass were considered. Finally, an investigation of frosted glass brought our attention to a technique of frosting by processing the glass right in the sash. This was being done by a local contractor. We decided to try it. We selected one of the worst trouble spots for heat and glare—a west wall with an assembly line running parallel to it—and ordered all of the glass frosted on the outside, with the exception of the bottom two rows of panes.

The results were satisfactory, to say the least. Transmission of visible light through the frosted glass was almost equal to that through clear glass, yet the diffusion of the sun's rays was so complete that no one has since complained about glare. While accurate temperature comparisons could not be made before and after the frosting, nearly all workers in the area said that it seemed cooler after the glass was frosted than it had been with the glass painted. In addition, the frosting gave the glass a pleasing whiteness and a surface which is unexplainably self-cleaning.

After three years, the frosted glass is free from dirt while the smooth, clear glass next to it has the greasy, dirty film you would expect to find on a factory window three years after cleaning.

Paid for in three years

The cost of frosting will be amortized in three years through the elimination of painting, exclusive of the electrical savings. Management was pleased with the results of the first experiment to the extent that all glass in the building except that with northern exposure has since been frosted.

After the glass was free from paint and natural light again brightened the interior of the plant, the question arose as to how the electric lighting could be controlled to take full advantage of the natural light. We also wanted to calculate just how much money, if any, would be saved by the combination of frosted glass and controlled artificial lighting. Since an average general illumination level of 20 foot-candles is sufficient to carry on manufacturing in this building, it seemed reasonable to turn the electric lights off during the day whenever natural lighting alone was sufficient to maintain a 30 foot-candle level.

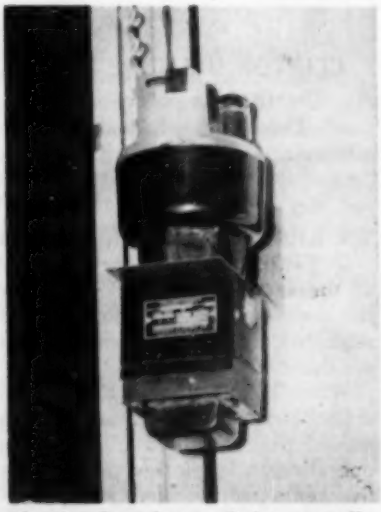
We had to recognize two major obstacles at this point. First was the capricious imagination of the individual employee with regard to lighting levels. Second was the method of determining the minimum daylight illumination level that would assure at least 30 foot-candles throughout the shop.

How illumination is controlled

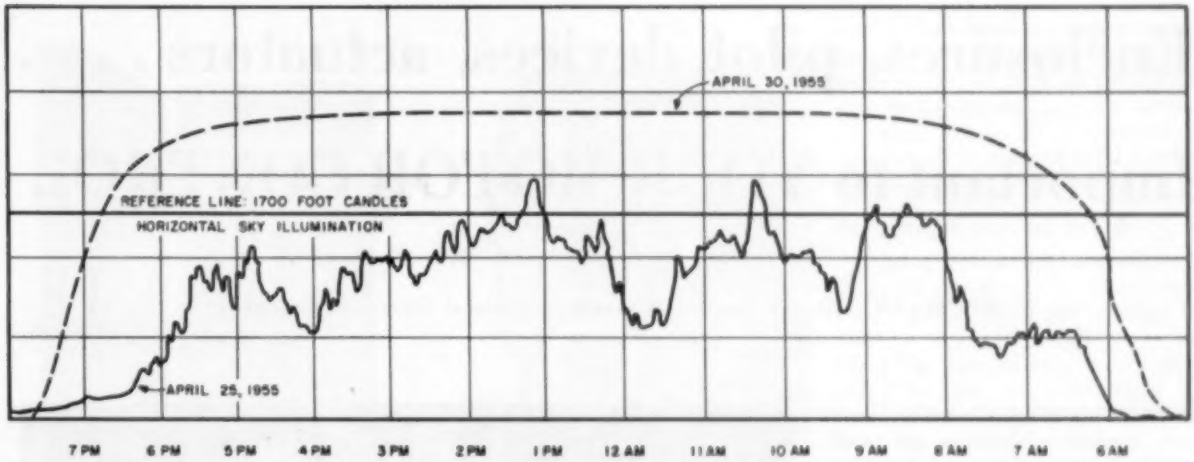
A photoelectric device, normally used for turning on and off street lights, was purchased. It was installed inside the plant in a position where it would not be affected by direct sunlight, and where it would receive light proportional to the average sky brightness at any time. The device was calibrated to energize signal lights whenever sky brightness is insufficient to provide at least 30 foot-candles inside the building. This type of unit might be combined later with a time-delay circuit to prevent action from momentary bright periods and for turning lights on and off automatically.

How much money would this system save in a year? To determine this, information was needed relative to the average outdoor illumination for all seasons of the year. Detroit Edison Company's lighting engineers informed us that they have such information in the form of a strip-chart recording of horizontal illumination from total sky for every day throughout the year.

For about two weeks, light-meter readings were taken at two-



Plant's photoelectric light controller faces unobstructed north skylights.



Lighting charts show that natural lighting level on clear bright spring day is high enough that artificial lighting is not needed. Dark cloudy day requires artificial lighting. Curves are logarithmic on vertical axis, though scale is linear.

or three-hour intervals inside the plant. By comparing the lighting levels inside with lighting levels outside (obtained from the charts for corresponding times), it was found that a close correlation exists between the inside and outside illumination. It was also determined that a certain minimum outdoor sky illumination, 1700 foot-candles, is required to provide between 30 and 40 foot-candles of illumination inside the building. With this information, a look at a daily lighting chart told just how many hours on that day that the electric lights might have been turned off.

The next step in the forecast of electric power savings was to examine the lighting charts and record the total number of working hours each month when sky illumination was 1700 foot-candles or more. This number of hours divided by the total number of working hours in the month gave an average percentage of the time when natural light alone was sufficient to illuminate the plant.

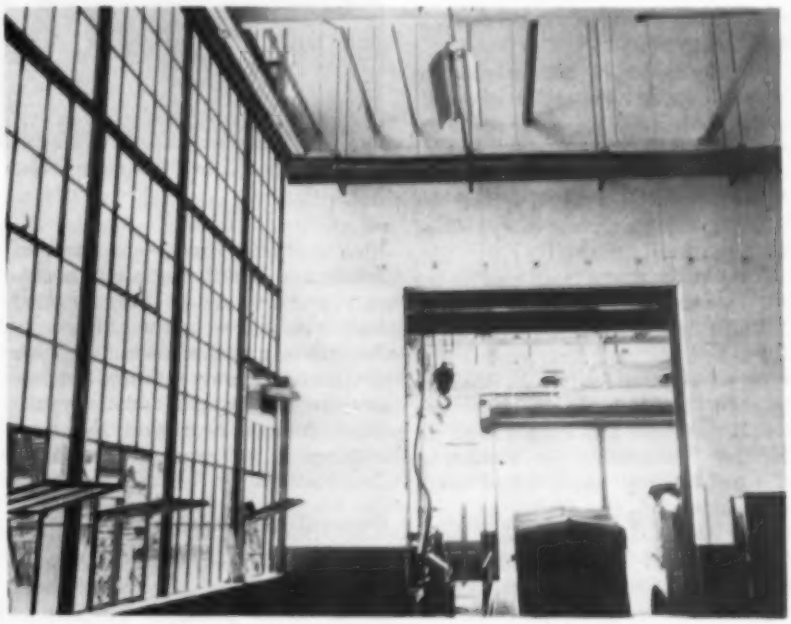
Wastage x cost=savings

Then the total number of working hours per month when lights could be off was multiplied by the cost per hour for electric power to obtain the probable savings. This data, taken for the months of December 1954 through March 1955, has been tabulated. It is based on 600 fluorescent fixtures, each with two 90 watt lamps. Including ballasts, the fixtures each have an input rating of 217 watts. Electric power currently costs $.0165 per kilowatt hour.

Month	Time Lights off	Hours month	Power Savings
December	30%	54	$116
January	44	79	$170
February	58.5	100	$214
March	82	147	$316

While only four months of the year have been considered here, they constitute the darkest season. It is reasonable to expect at least the same savings in the other two thirds of the year. In addition, there will be considerable money saved in increased lamp life and decreased labor for lamp changing. Estimated annual savings in electrical power alone is $2448.00 or $18.80 per kilowatt of installed lighting per year.

When the dollar savings are considered along with the greatly improved appearance of our plant, comfort to employees, and the relief from the nuisance of painting and cleaning the glass, it is easy to see why we are glad we took the cover off our windows and skylights and let the sunshine in.



Interior of south wall demonstrates how bright, diffuse lighting streams through the frosted glass. Spare frosted panes are kept for normal losses.

Enclosures, pilot devices, actuators . . . . Important to YOUR MOTOR CONTROL

G. W. HEUMANN, Industry Control Department, General Electric Company

I&P EXCLUSIVE

INDUSTRY-STANDARD motor control enclosures are available in a wide variety of constructions to fit every industrial environment. Open control panels with exposed current-carrying parts—such as switches, terminals, and bus—constitute a hazard to operating personnel who may come in contact with them. Open panels are still widely used in large mills that have separate control rooms, accessible only to trained maintenance crews. They are also used on special machinery, such as overhead cranes, that is remote from the manufacturing floor, and that is operated only by specially trained personnel. Under no circumstances should open panels be installed in a production area because of the danger of accidental contact by unwary workers. Enclosed controllers should be selected for installation near production machinery.

Enclosures may be designed to protect against atmospheric conditions such as dust, dirt, splashes, drips, or corrosive fumes. Explosion-proof enclosures protect against explosions that may be touched off by arcing in explosive atmospheres.

To aid in specifying enclosures for various service conditions, NEMA has established standard type designations that define the type of service for which the enclosures are intended. These type designations are explained in NEMA "Standards for Industrial Control." They have found wide acceptance by the trade, and are to be found in handbooks, sales bulletins, and the standard specifications of control manufacturers.

Enclosures may be ventilated or non-ventilated. If heat dissipating apparatus—such as resistors, reactors, or transformers—is mounted inside and ventilating air is necessary to carry away the generated heat, enclosures are ventilated by louvers or screened openings. Type designations for ventilated enclosures are the same as for non-ventilated ones, except that the type number is followed by the word "ventilated."

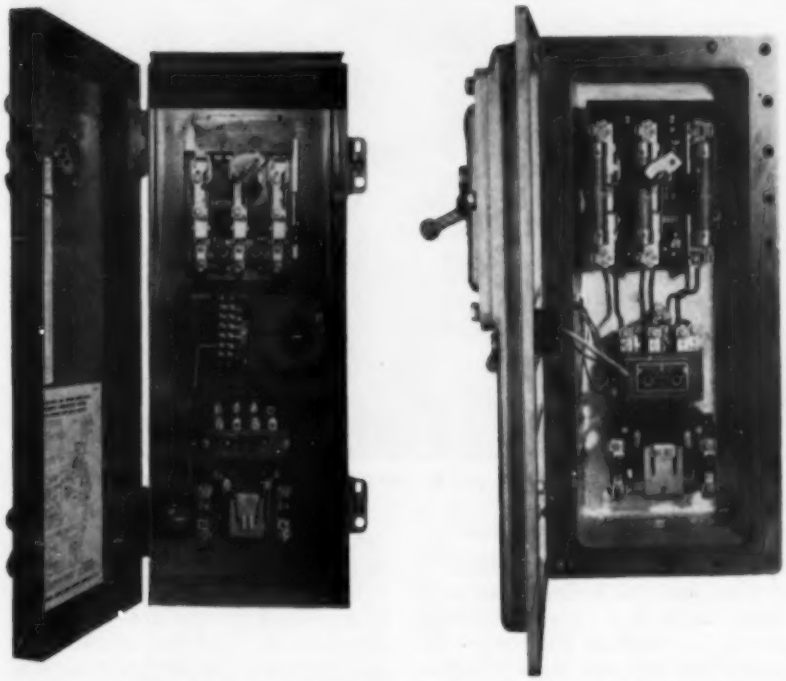
Several pushbuttons mounted in one assembly give true finger-tip control.

General industrial types

NEMA type-1 general-purpose enclosures are constructed of sheet metal. Their principal purpose is to give protection against accidental contact with live parts, and protection against damage from falling objects. While type-1 cases afford some protection against falling dust, they don't keep out dust when installed in heavily laden atmospheres.

A drawn-shell enclosure is generally used to house a starter or some other small piece of apparatus. The case proper and the cover are deep-drawn pieces. The cover is slipped over the edge of the case and held in place by a screw. Knockouts are often provided for conduit connections.

Larger cases are fabricated of pre-formed steel sheets, joined by



Type-12 JIC box (left) has no openings or cracks, but has gasketed door. Class-1, Group-D, explosion proof, has no gasket but closely-spaced screws.

bolting, spot welding, or seam welding. They generally have a hinged door in front. The back may be solid, hinged, or removable. These enclosures are usually open at the bottom for conduit. If conduit is brought in from the top or sides, the case is drilled during installation.

Type-1 enclosures are sometimes equipped with a gasket between the case and the door or cover. The erroneous impression that gasketed construction adds to dust protection still persists. Remember that a cover gasket can only give additional dust protection if the rest of the case is dust-tight. Simply specifying type-1 gasketed construction gives no assurance that dust will not enter through conduit openings or cracks between the sheets that make up the enclosure.

Type-12 enclosures are designed to protect against certain hazards around industrial plants. They are constructed so that the case itself has no gaps or cracks through which oil or coolant may enter from the back. There are no conduit knockouts or openings, no unused holes for mounting apparatus in the enclosure, and no mounting holes. Instead, external mounting feet are provided. An oil-resistant synthetic gasket is installed between case and cover. Type-12 enclosures are used around machine tools in high-production metalworking plants and in textile, tobacco processing, and similar industrial plants. They meet JIC standards, and provide protection against entrance of dust, lint, fibers, and flyings.

Specific atmospheric hazards

Type-2 cases are driptight for use in locations where heavy condensation may occur. Cases are fabricated of sheet steel similar to type 1, except that the top slopes and overhangs the door. Thus, it forms a drip shield so that water runs off without entering the case around the door. Type-2 cases may be used in such locations as cooling rooms or laundries.

Type-3 cases are weather resistant and suitable for installation outdoors where they may be exposed to sleet and rain. Small cases are sometimes cast. Larger cases are generally fabricated. They have drip shields like type-2 cases, but some means of preventing wind-driven rain from damaging equipment within the enclosure is provided. One way of accomplishing this is by having gutters around the door cracks so that driven-in rain water is drained off before it gets deep into the case.

Watertight can be hosed

Type-4 cases are watertight. They may be of cast- or sheet-metal construction. They are suitable for outdoor use on docks. They are ideal for dairies, breweries, paper mills, or any location where the controller may be hosed down for cleaning. A type-4 case must meet a standard hose test. A stream of water from a hose not less than one inch in diameter, and delivering at least 65 gpm, is played on the controller for five minutes from a distance of not less than 10 feet. No water must enter the enclosure.

Type-5 denotes dust-tightness. Type-4 cases generally meet the requirements of type-5. Growing popularity of type-12 enclosures has largely eliminated need for separate type-5 listings.

Phosphate treatment of the sheet steel, followed by a suitable baked-on or air-dried organic finish provides adequate protection against mildly corrosive contaminations. Even in atmospheres with considerable corrosive effects, an extra coat of organic paint generally gives satisfactory life.

Corrosion occurs in the presence of moisture. Eliminating moisture condensation by proper installation and by the use of space heaters inside the enclosure goes a long way toward prevention of corrosion.

Galvanizing should not be specified for fabricated enclosures. Fabrication of galvanized sheet exposes unprotected metal at the cut edges. Galvanizing a fabricated case is an expensive procedure, and it often leaves the case badly distorted. In extreme cases where a paint finish simply will not stand up, the use of appropriate noncorrosive material, such as aluminum, should be specified.

Hazardous locations

Hazardous atmospheres may contain flammable or explosive gases, vapors, or dust. The National Electrical Code defines classes of locations by certain groups of ex-

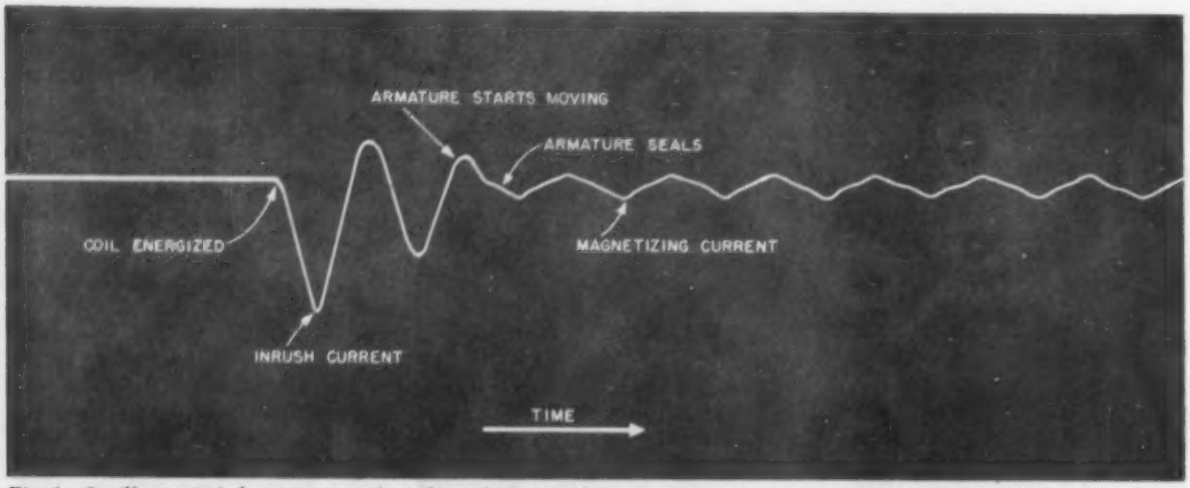


Fig. 1—Oscillogram of closing a-c magnet shows high inrush current as coil is energized, low current as magnet closes.

plosive atmospheric contaminants:

Class I, Group A: acetylene
Group B: hydrogen or gases or vapors of equivalent hazard, such as manufactured gas.
Group C: ethyl ether, ethylene, or cyclopropane.
Group D: gasoline, hexane, naphtha, benzene, butane, propane, alcohol, acetone, benzol, lacquer solvent vapors, or natural gas.
Class II, Group E: metal dust.
Group F: carbon black, coal, or coke dust.
Group G: flour, starch, or grain dust.
Class III: combustible fibers or flyings.

Underwriters' Laboratories, Inc. have established design specifications and testing procedures for enclosures suitable for Class-I and Class-II locations. It is assumed that explosive gas will enter the enclosure, and an explosion inside is expected. The enclosure must be designed so that it will resist the force of explosive pressure by virtue of its strength, and will prevent escape of flame through joints, operating shaft openings, screws, rivets, and conduit openings. Fig. 2b shows a Class-I, Group-D enclosure for air-break apparatus. It is fabricated of boiler plate with wide flanges and closely-spaced screws for holding the cover. No gaskets are allowed. As an alternative, the apparatus may be immersed in oil so that all arcing occurs under oil.

Enclosures for Class-II locations must be constructed so that the specified dust does not enter the enclosure. Wide flanges are specified, or non-rubber and mechanically held gaskets may be used. For Class-III locations, NEMA type-5 or type-12 enclosures are deemed adequate.

Motor control centers

When a number of motors are located within a plant area, it becomes economically advantageous to group the various controllers in a motor control center (Fig. 5). Individual motor starters are mounted in individual, standardized frames. These frames are mounted in compartments of a standardized enclosure structure that consists of a number of vertical sections. Horizontal line busses are carried in the top portion of the structure. Each vertical section contains vertical bus risers to which the power circuits of the individual controllers are connected by pressure-type contacts, or "stabs." Thus, individual units can be easily removed for maintenance. All service can be performed from the front, so control centers can be placed against walls, or back-to-back to save floor space.

Control centers are coordinated

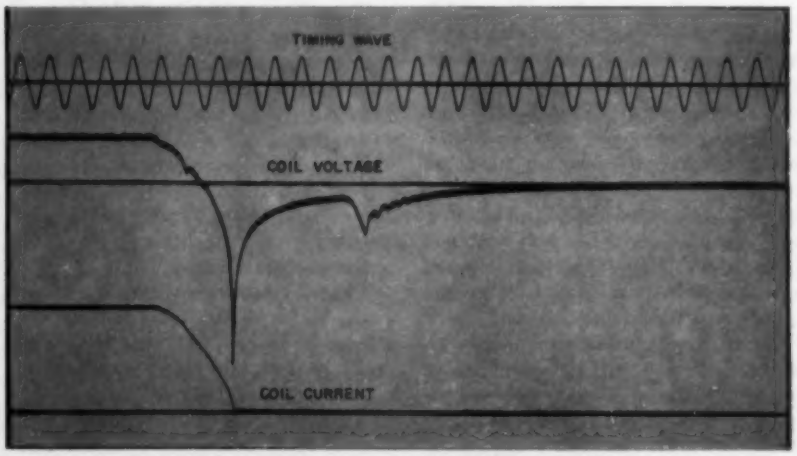
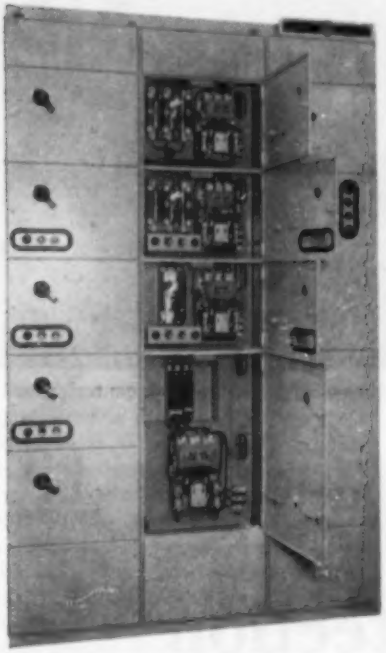


Fig. 2—Closing of a d-c magnet presents difficulty in breaking of coil current.

systems which include the functions of motor control, overload protection, and short-circuit protection. Electrically, the controllers in the control center are combination controllers. Control centers have a stated interrupting rating in terms of available short-circuit current of the power system to which they may be connected. The manufacturer assumes the responsibility for proper selection and coordination of components, for interconnecting wiring as required, and for testing of the whole assembly.

Although a control center is more costly than individual controllers, it reduces installation costs and is attractive from an overall cost point of view. The orderly, and easily-accessible arrangement is conducive to good maintenance. Since they are built up of standardized sections, they provide flexibility for accommodating future plant expansion.



Motor control center houses several starters, saves space, maintenance time.

Pilot devices are those controls (manually or automatically actuated) that are connected in circuits actuating magnetically operated devices. They must be capable not only of carrying, but also of making and breaking the coil current of electromagnets.

Fig. 1 is an oscillogram of the closing of an a-c magnet. With the magnet initially open, coil impedance is low and a high "inrush current" is drawn. As the magnet armature closes, coil impedance increases, and only "magnetizing current" is drawn with the magnet closed. Normally, the pilot device interrupts only the magnetizing current, which generally occurs when current passes through zero. In an emergency, however, the pilot device must be capable of interrupting the inrush current of a magnet that is blocked open.

When d-c magnets are switched, making of coil current presents no problem since there is no inrush. Coil current rises gradually from zero to magnetizing current. But, breaking d-c coil current is more difficult than breaking a-c current, as is illustrated by the oscillogram of Fig. 2. When pilot-circuit contacts part, an arc is drawn that must be interrupted by elongation. A high voltage is induced in the magnet coil by the decay of current. This voltage tends to maintain the arc. D-c interrupting ratings of given pilot devices are generally much lower than corresponding a-c ratings.

There are no nationally recognized standards on rating of pilot device contacts. Manufacturers' listings of carrying, making, and breaking ability must be consulted to select the proper pilot device for a given control application.

Pushbuttons for simplicity

Pushbuttons are manually actuated switches, generally "momentary contact" type. This means that they remain actuated as long as the button is pressed. The contacts automatically return to their original position as soon as the button is released. Various types of actuators may be obtained—such as mushroom heads, long buttons, key locks, turn buttons, or latched buttons for "maintained" contact.

Individual units may be flush-mounted on equipment. They may be assembled into a pushbutton station for surface mounting.

Two classes of pushbuttons are recognized by the trade. They are designated "standard duty" and "heavy duty," and have different contact ratings with respect to make and breakability. Table 1 gives current ratings of a typical line of pushbuttons.

Limit switches control movement

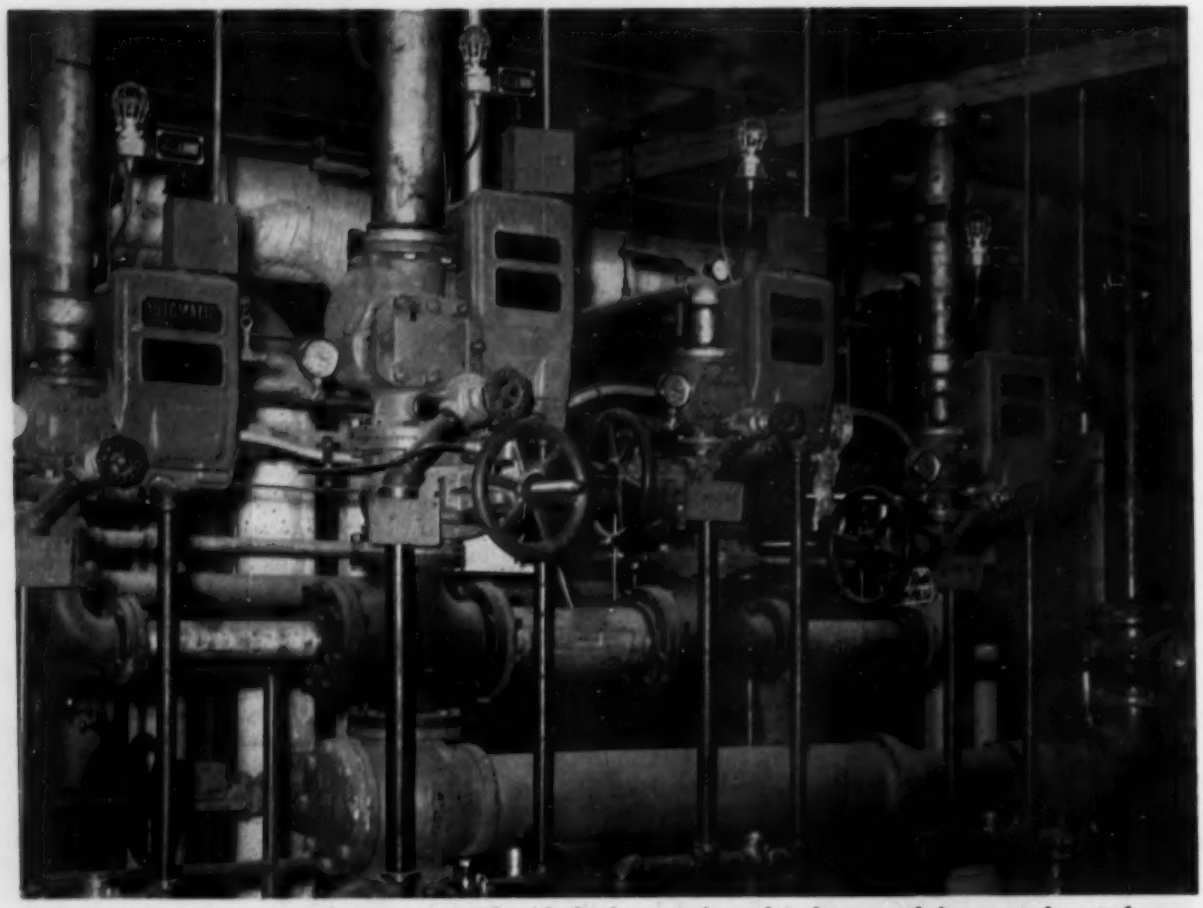
Limit switches are mechanically actuated by the movement of machine parts. They may be used for automatic stopping to "limit" machine travel. They may also be used for interlocking and sequencing. Track-type limit switches are actuated by cams or dogs that change contact position through an operating lever. Geared limit switches consist of a turning shaft, which is gear- or chain-driven from the machine, and which actuates the contacts through cams or dogs. By setting cams, contacts are actuated at various points in machine travel. Contact ratings, must be obtained from the manufacturer.

Similar switches can be obtained to respond to process characteristics. Pressure switches are actuated by rising or falling pressure through linkage to a diaphragm. Float switches respond to liquid level through floats, which actuate the contacts by chains or rods. Thermostats are actuated by temperature changes through expansion or contraction of a gas-filled bellows. All of these switches may be utilized for the automatic starting and stopping of motors with magnetic controllers.

TABLE 1

CURRENT RATINGS IN AMPERES OF A TYPICAL LINE OF PUSHBUTTONS

			Interrupting rating						
	Make at all voltages	Carry Continuously	D-c inductive at volts			A-c inductive at volts			
			115	230	550	110	220	440	550
Standard duty	30	10	1.1	0.6	0.2	30	20	7.5	6
Heavy duty	60	10	2.2	1.1	0.4	60	30	8	6



Control station for fog system that protects inside of boiler house is located in basement below central control room.

Raritan River Station extension gets

I&P EXCLUSIVE

Tailor-made *FIRE* protection

AMBROSE J. GEGAN, JR.
Project Engineer
Burns and Roe, Inc.

FIRE PROTECTION is tailored-to-the-hazards by integration of fire-fighting devices most appropriate to specific areas for maximum safety to station and crew at Raritan River Station of Jersey Central Power & Light Company. This modern fire protection system was installed as part of the station expansion just being completed. The new turbogenerator unit now being added will increase station capacity by 125,000 kw. The extension was designed by Burns and Roe, Inc. The present extension is the first of a pair of unit stations to be installed, each composed of a cyclone boiler and a tandem compound, triple-flow, turbogenerator operating at 2000 psig and 1050 °F at the throttle, with 1000 °F reheat steam.

The station extension is housed in what is largely a fire-resistant structure, composed of concrete,

steel, and cement-asbestos siding. All thermal insulating materials specified for the boiler and pipework are of fire-resistant material. Despite these precautions, there still exists considerable potential fire hazard in the lubricating oil system of the turbogenerator.

Oil in hazardous locations

The turbine oil reservoir must be located in a certain, definite position near to the throttle end of the turbine. Furthermore, it is usually advantageous to locate the clean and dirty oil tanks as well as the lubricating oil purifier close to the turbine oil reservoir. Sizable fire hazard is presented by this equipment, plus the oil lines supplying the turbogenerator bearings and all the control valves and mechanisms. Oil in tanks totals 4500 gallons, with an additional 965 gallons being circulated in the lines.

In addition to the hazard presented by oil tanks and reservoirs, lubricating oil lines to and from the turbine bearings present a special hazard around the front and middle bearing pedestals. Outside the station, the main and service transformers are the greatest hazard.

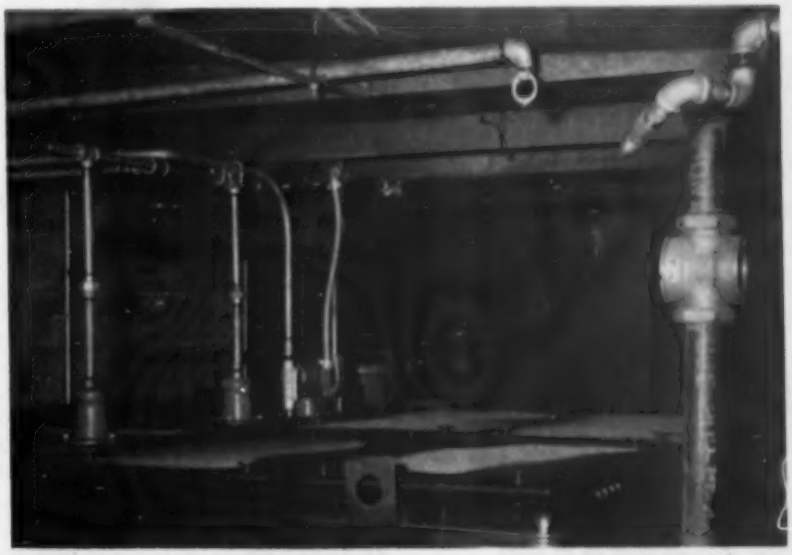
Water for major system

Backbone of the station fire-fighting scheme is the water system. A standpipe system running throughout the station is fed by gravity from a 100,000-gallon elevated city water storage tank or by the discharge from an engine-driven fire pump. The city water tank feeds directly to the fire pump and to the standpipe system through a pump bypass and check valve. If water is used from the standpipe system, it feeds around the pump thereby opening the check valve. Opening of the check valve is indicated on an annunciator at the fire control panel in the central control room. At this signal, the central control room operator can start the fire pump remotely. All operating controls for fire pump operation are repeated in the central control room, duplicating controls at the pump.

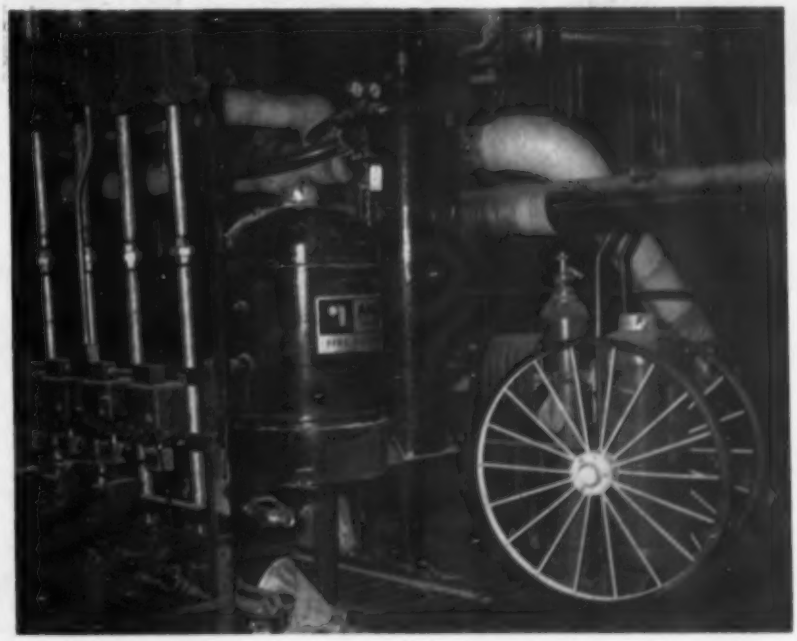
The elevated storage tank gives a static pressure of 60 psig in the station basement, whereas the fire pump gives a pressure of 130 psig at the pump discharge. This pump pressure is sufficient for all of the connected facilities, regardless of elevation in the station. Hose racks with 75 feet of hose are located throughout the station to give complete coverage.

Outside the station, hose houses (complete with hydrants, 200 feet of hose, axes, and spanners) are located to give complete coverage of the exterior hazards. Some of the hose houses are connected to the standpipe system, while others are connected directly to the city water mains feeding the station. All hose racks and hose houses are furnished with fog nozzles, which is Jersey Central Power & Light Company standard practice.

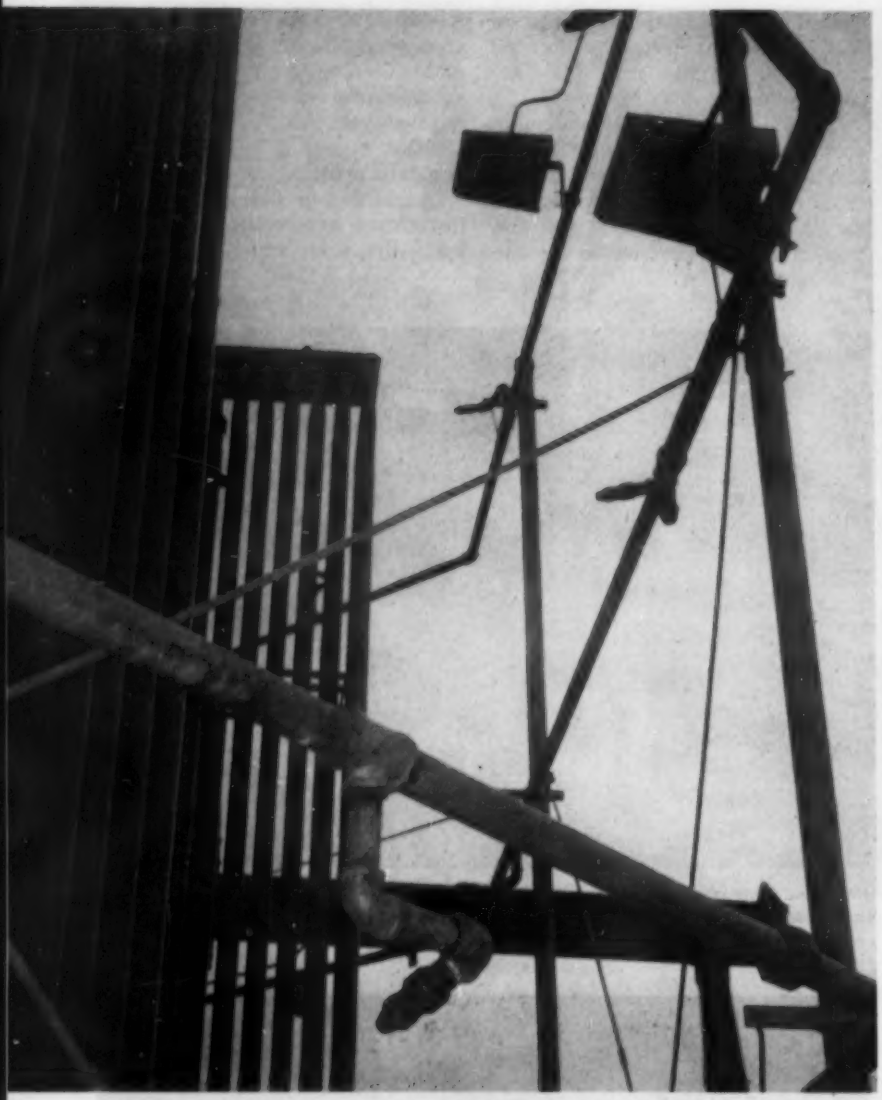
In addition to the hose racks in the station, hand-carried dry chemical units are located throughout



Protection for lube oil purifier consists of external fog nozzles and CO_2 nozzles inside tanks. These are covered by bushing-type mountings (center, left).



Dry chemical station has a 150-pound wheeled unit and a fixed unit that is piped to turbine front and middle bearing housings, and to area below turbine.



Transformer fog system showing heat-actuated devices (upper right) and nozzle.

the station on all floors and elevations. In addition, 150-pound wheeled dry chemical units are located in the turbine room on the operating floor and basement level. Another wheeled unit is located at the soot blower air compressors.

Fog protects transformers

Power is fed from the new turbogenerator to the Jersey Central Power & Light Company transmission system through a 140,000-kva step-up transformer. Station auxiliary power is fed from the generator leads to a 4160-volt bus through a 10,000-kva transformer. Station auxiliaries also can be fed back from the transmission system through two 5000-kva transformers. Each of these transformers is protected by a fog system fed from a control station. These systems can be discharged automatically by local heat-actuated sensing devices or by a remote manual release in the central control station.

The lubricating oil system consists mainly of a turbine oil reservoir, a flow-back tank, a Bowser purifying unit, a two-compartment storage tank, piping, and pumps. This equipment, together with the seal oil unit and the H_2 control panel, is grouped in the turbine room basement in an aisle between the turbine foundation and an interior partition wall. Oil lines to and from the turbogenerator are hung from the ceiling at their required elevations in this aisle, also. All oil lines and equipment, therefore, are located in this isolated area. All steam lines to and from the turbine are brought out the opposite side, or from the front of the machine.

Trenches isolate oil

The basement floor has been trenched to isolate the area and prevent leaking oil from spreading over the entire station basement. This entire area is protected by a fog system that will control or extinguish fires either in space, on equipment, or on the floor in this area. In addition, any pits into which burning oil might flow upon a serious break are also protected by the fog system.

This fog system is divided into four separate sections, all of which are brought into operation by local heat-actuated devices or by a manual release in the central fog control station. From the control station, which is located outside of the area protected, any or all of the separate sections can be cut off if the fire is not in that section. This prevents overloading of the basement sump pumps.

Tanks have CO_2 system

Interiors of all the oil tanks are protected by a CO_2 system actuated by automatic release or by a remote operation in the central control room. The CO_2 bottles are located on the operating floor just outside of the central control room so that it is isolated from all hazardous areas. CO_2 is piped from this station to each of the oil tanks. Each oil tank has a heat-actuated device, which not only releases CO_2 into it but also into all the other tanks.

Despite an effort to keep the lubricating oil lines isolated from the steam lines by running them on the opposite sides of the machine, the lines that supply the bearings must, of necessity, pass near hot steam lines or the hot shell of the turbine. Hence, protection is necessary in and around the turbine front and middle bearing pedestals, where steam temperatures run near 1000 °F. Protection is also needed under the turbine and around the foundation.

Since this area is quite open and subject to moderate drafts, CO_2

was not considered suitable. Fog was not acceptable because of the high equipment temperatures. Dry chemical was chosen as the best medium for protection. Dry chemical nozzles were installed on the turbine front and middle standards (or bearing housings), where the shafts pass through the bearing enclosures and where oil could leak and contact the hot turbine shell. Dry chemical nozzles are also located beneath the turbine, where oil lines must pass near hot steam pipelines.

Manual or automatic operation

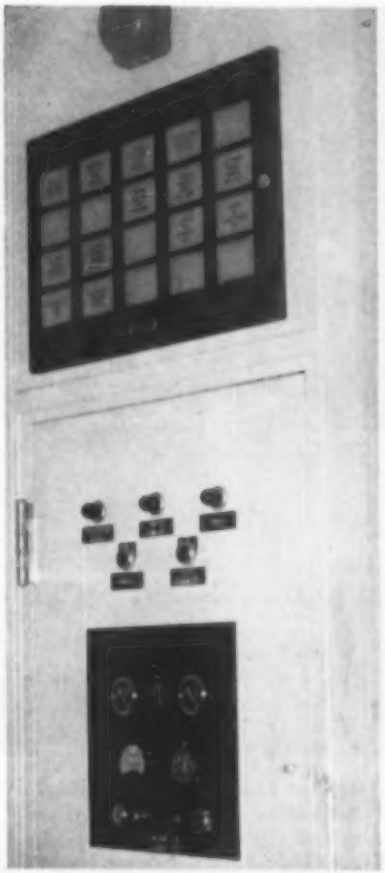
Heat-actuated devices will automatically release the dry chemical system, or it can be manually operated from the central control room. A portable wheeled dry chemical unit is stationed adjacent to the turbine foundation on the side opposite from the oil lines. It can be used independently or it can be connected to the permanent system if required. A portable wheeled unit is also located on the operating floor for manual use on the turbine front and middle standards.

The fire protection and control system for the station extension is laid out to allow operation by the regular station operators if the occasion should require. Normally, the station fire brigade will take charge in an emergency.

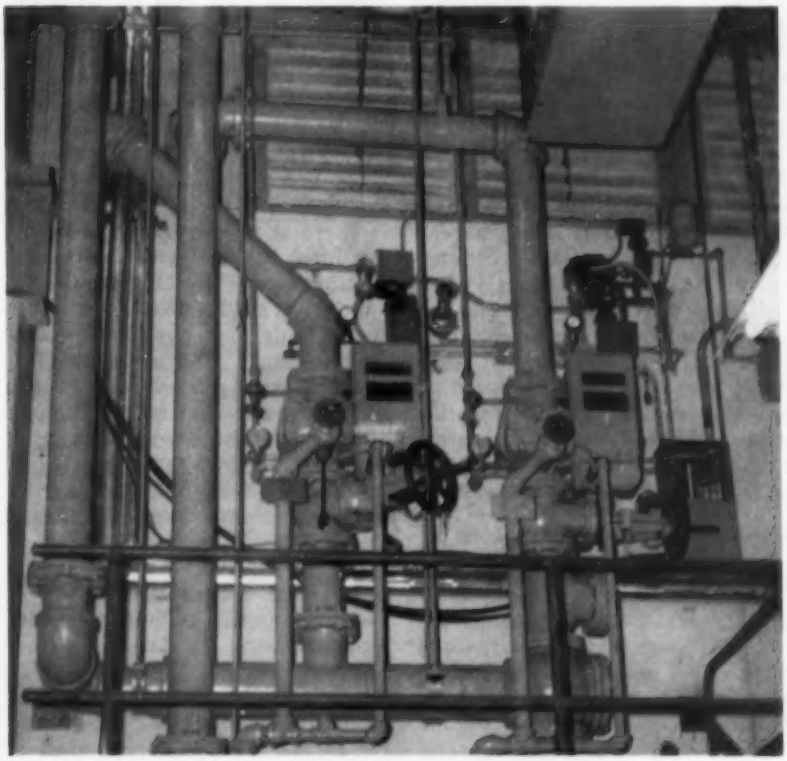
About September, 1953, the fire brigade was organized to function under the station superintendent. Chairman of the brigade is an exchief of a local volunteer fire company. Assistant chairman of the brigade is also an officer of a local volunteer fire company. Station departments represented on the brigade are mechanical maintenance, electrical maintenance, utility, and operations.

Thorough education policy

All men in the station as well as the fire brigade are trained in the use of all fire protection equipment. A special alarm (separate and distinct from all other station whistles and horns) signals fire and indicates the general location of the fire. Fire brigade members on duty then report to their stations, take up equipment, and proceed to the fire location. All fires are reported in detail by the chairman or assistant chairman.



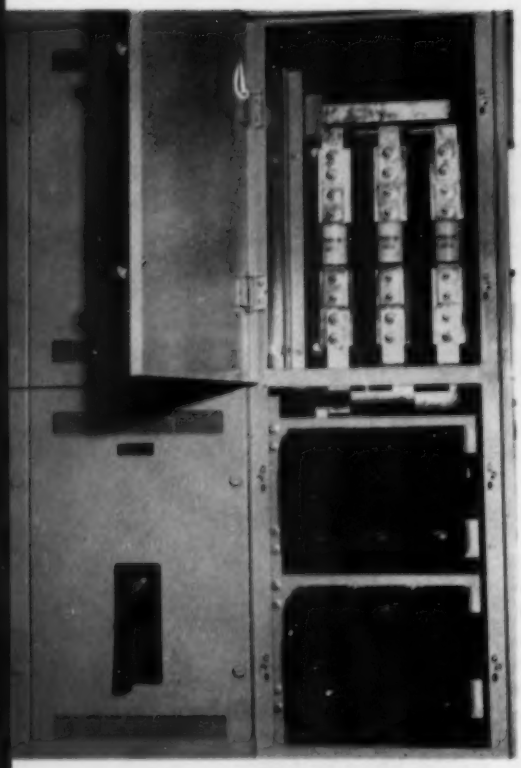
Central fire control station panel showing annunciator and fire pump starter.



Transformer fog system control station. System can be discharged automatically by heat-actuated devices or manual control from central control station.

All personnel report fire hazards to the station superintendent for correction. Detailed inspections are made monthly by the brigade. Conditions are discussed at a monthly meeting. Once a month, an unscheduled fire drill is called during which a simulated fire is fought and equipment is tested. The engine-driven fire pump is periodically started and run for a sustained period to insure availability when required in an emergency.

In summation, the Raritan River station extension is designed to minimize all fire hazards and provides facilities for extinguishing or controlling fires resulting from the hazards that could not be eliminated. Protection is selected to match the particular conditions imposed by each hazard, resulting in a tailored-to-order power station fire protection system.



Use lower IC BREAKERS by coordinating WITH current-limiting FUSES

M. S. CARLSON and A. CONANGLA
I-T-E Circuit Breaker Co.

Coordinate current-limiting fuses with your low-voltage circuit breakers so that the fuses take over the severe interrupting duty. You then can use less costly breakers.

YOU CAN SAVE money on low-voltage circuit breakers by using breakers of lower interrupting capacity and using current-limiting fuses to take over the severe interrupting duty. Current-limiting fuses are rapidly gaining acceptance for fault protection beyond the range covered by breakers. Fuses are now available with time-current characteristics such that they open the circuit very rapidly at high currents, but let the breaker do the interrupting job when the fault is the breaker's interrupting capability.

Proper application of large air and molded case circuit breakers requires that they have interrupting ratings commensurate with the maximum short-circuit currents available at their location in the particular circuit. Where the available short-circuit current is very large, full protection requires a very large and expensive breaker.

By cascading breakers, or by feeding switchboards and panelboards through cable runs or through current-limiting reactors that have considerable impedance, it has been possible to apply smaller breakers safely. These expedients are sometimes justified by economies achieved in first cost, but they involve some sacrifice in the degree of protection afforded or in the voltage regulation of the distribution system.

Present trends are toward larger concentrations of power at utilization voltages. Network systems can deliver 180,000 amperes symmetrical in some locations. Large office buildings are using 12,000-kva transformer banks, and even larger ones are being planned. In some cases, the available short-circuit currents exceed the interrupting capacity of the largest existing breakers, and make it imperative to build reactance into the system.

Compound advantages of each

Coordinated applications of air circuit breakers and current-limiting fuses possess definite advantages in these situations not realized when either one is used alone. Current-limiting fuses can interrupt fault currents in excess of the breaker interrupting capacity, and can do so without damage to the breaker if properly applied. The breaker, in turn, can be arranged to interrupt all minor overloads, thus avoiding time-consuming fuse replacement. Proper application of breaker-fuse combinations requires thorough understanding of fuse and breaker characteristics plus knowledge of the magnitude of the fault currents available in the system.

There is no advantage in backing up a breaker with a current-limiting fuse when the interrupting capacity of the breaker matches the worst fault that can be expected in the circuit. The installation of current-limiting fuses permits use of breakers having reduced interrupting capacities, with a definite first-cost advantage, especially when one set of fuses is used to back up several feeder breakers.

Ideal combination

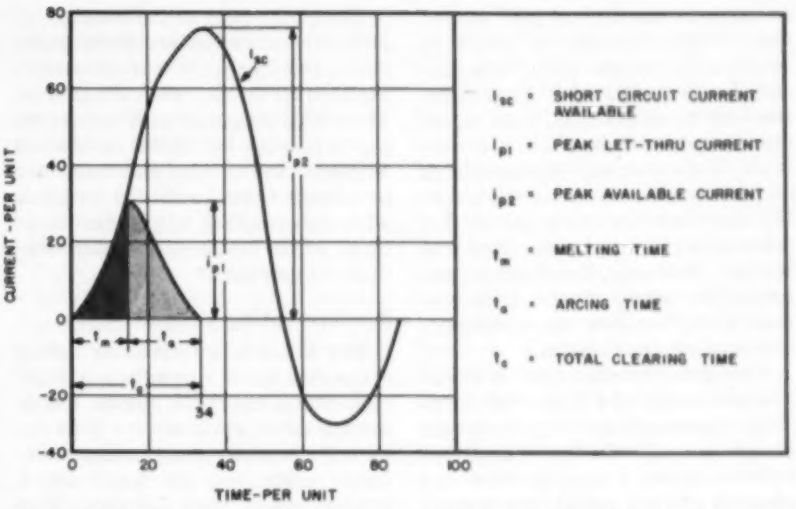
An ideal combination is where the fuse limits faults to a value that will cause no damage to the breaker, and where the fuse will not blow on currents within the interrupting capacity of the breaker. Both conditions cannot always be fully satisfied. Compromises for overprotection to the breaker are

necessary in practical installation to insure against damage to the breaker on very severe faults. Obviously, it is cheaper and less cumbersome to replace a blown fuse than it is to repair a circuit breaker damaged by a fault.

Let us now consider the individual characteristics of the fuses and breakers that are of prime importance to the problem of coordination. These are the short-time, or fault, characteristics.

Current-limiting action is achieved when the fuse element melts before the current has reached its maximum available value. When a fuse element melts in this way, it vaporizes and becomes an arc that has considerable resistance. The fault current goes down to zero and to extinction.

Maximum available current is that which would flow if there had been no current-limiting fuse in the circuit. The melting time, t_m, is the time needed to heat the fuse to its melting temperature, when it vaporizes. The arcing time, t_a, is the time of the arc appearing, cooling, and its extinguishing. The peak let-through current is the maximum instantaneous value of current which passed through the fuse.

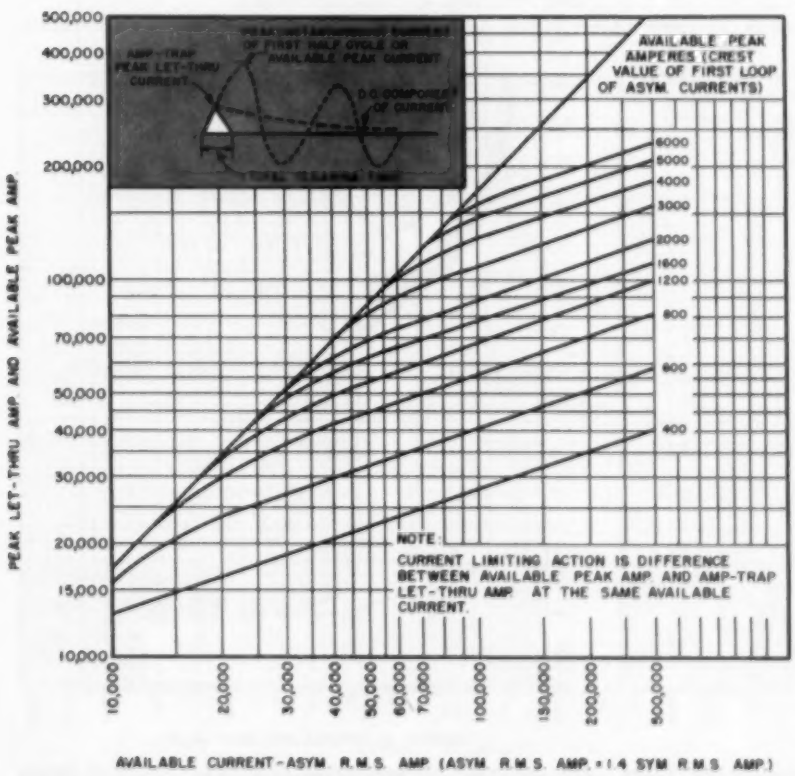

CURRENT - PER UNIT
TIME - PER UNIT
I_{sc} = SHORT CIRCUIT CURRENT AVAILABLE
I_{pl} = PEAK LET-THRU CURRENT
I_{p2} = PEAK AVAILABLE CURRENT
t_m = MELTING TIME
t_a = ARCING TIME
t_c = TOTAL CLEARING TIME
34

Current-limiting action of Amp-Trap fuse element used on alternating current.

Melting time in a true current-limiting fuse is substantially less than the first half-cycle of fault current. Arc resistance after melting must be high, so that there is very little rise in the fault current after melting. Some so-called *high-interrupting-capacity* fuses are not really *current limiting*.

The rate of heat generation in the fuse element at every instant is proportional to the square of the current at that instant. The heat generated in a time Δt is equal to $I^2\Delta t$. Total heat generated in an interval, such as t_m, is equal to the summation of $I^2 \triangle t$ over the interval. The heat generated in the fuse element raises its temperature to the melting point, and the fuse blows.

It is a known fact that in the high-current range, the melting temperature is reached when the summation of $I^2 \Delta t$ reaches a predetermined value, which is a constant and a characteristic of the particular fuse design. Thus, the manner in which the fault current rises has an effect on the melting time, and on the current value attained at the instant of melting. A faster rising current will melt the fuse sooner, at a higher instantaneous value.


PEAK LET-THRU AMP AND AVAILABLE PEAK AMP
AVAILABLE CURRENT - ASYM. R.M.S. AMP (ASYM. R.M.S. AMP. ÷ 1.4 SYM. R.M.S. AMP.)
AVAILABLE PEAK AMPERES (CREST VALUE OF FIRST LOOP OF ASYM. CURRENTS)
AMP-TRAP PEAK LET-THRU CURRENT
D.C. COMPONENT OF CURRENT
NOTE:
CURRENT LIMITING ACTION IS DIFFERENCE BETWEEN AVAILABLE PEAK AMP AND AMP-TRAP LET-THRU AMP AT THE SAME AVAILABLE CURRENT.

Available let-thru current characteristics of Form 480 current-limiting fuses.

Fault current duration

The time taken for the fault current to go to zero after reaching its peak value is affected by the circuit voltage, by the value of the peak, and by the characteristics of the fuse. This value, from test, is about 1.5 to 3 times greater than the time taken for the current to reach the peak value.

Melting time-current characteristics of a Form 480 Amp-Trap current-limiting fuse are shown in Fig. 1. The currents are in rms amperes actually flowing in the circuit, time

in seconds starting at 0.01 second. Below 0.01 second, or about ½ cycle on a 60-cps basis, the fuse may begin to limit the current, depending upon the maximum short-circuit current available in the fault. Time-current characteristics of fuses are not suitable for showing current-limiting action that takes place in a time less than 0.01 second. However, these curves are useful for study of the coordination with breaker characteristics in lower current ranges.

Available let-through current characteristics of a Form 480 Amp-Trap current-limiting fuse are shown on page 63. Here, available fully displaced rms amperes of one phase is plotted against the instantaneous peak let-through amperes for various ampere ratings of fuses. The current-limiting action is a function of the available short-circuit current. Low-ampere-rated fuses are definitely current-limiting over a wide range of available fault currents and the rated current of the fuse. Higher-ampere-rated fuses require large values of available fault current to become current limiting. Both of these characteristic curves are necessary for the solution of a problem involving a fuse-breaker application.

Now, let's turn to the breaker. A circuit breaker has an interrupting rating in amperes. We are considering here air breakers in ratings from 15 to 6000 amperes with interrupting capacities of 15,000 to 150,000 amperes, and molded case breakers in ratings from 10 to 600 amperes with interrupting capacities from up to 40,000 amperes (on manufacturers approval.)

Breaker rating defined

The breaker interrupting rating is the average of rms values of fault currents in the three phases, measured one-half cycle after a fault occurs. Each phase current has a different value, one (at least) being greater than the average. This means that any one pole of the circuit breaker has to withstand, thermally and mechanically, a current greater than its rating. This value of current depends on the X/R ratio of the circuit. Large air circuit breakers are tested on circuits where the X/R ratio is specified as 11.72, or 8.5-percent power factor. A fault with one phase fully offset will subject one pole to a total rms current, at ½ cycle, of 1.18 times the average rms current rating. Current in this phase reaches a peak ampere value equal to approximately two times the average rms value. For example, a breaker having an interrupting rating of 25,000 amperes would have one pole subjected thermally and mechanically to a 50,000 amperes peak.

Low-voltage air circuit breakers are equipped with direct-acting overcurrent trip devices responsive to current. Such a device is provided with two elements, one to take care of short-time overloads and one for fault currents. The short-time overload device covers the overload range of currents, and is adjustable from 80 to 160 percent of breaker rating. Three time bands —minimum, intermediate, and maximum—are provided to give better selection of a time band in the overall coordination problem. The short-time, or instantaneous, trip covers the fault current range. It is adjustable from 5 to 15 times the breaker rating. The combination is called a dual magnetic overcurrent trip device.

Typical time-current characteristics of large air circuit breakers are shown in Fig. 2. The upper portion of the curve shows the overload characteristics. The lower portion shows the short-time, or fault, characteristics.

When used in a selective system,

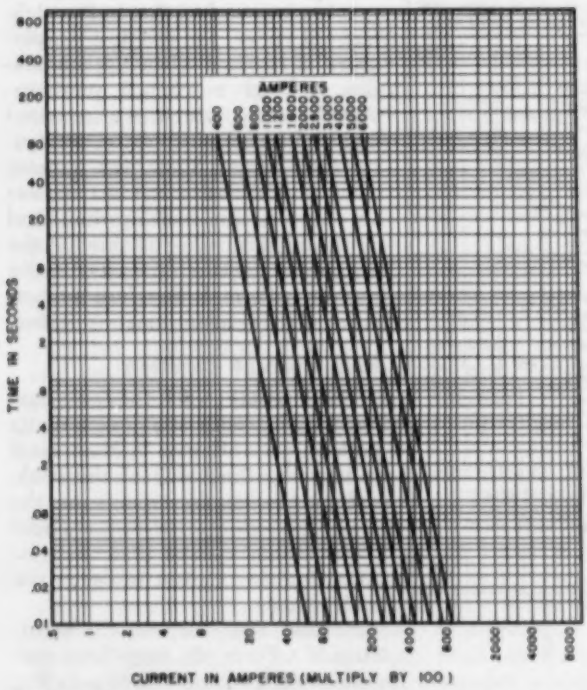


Fig. 1—Melting time-current characteristics for Form 480 current-limiting fuses with current in rms amperes.

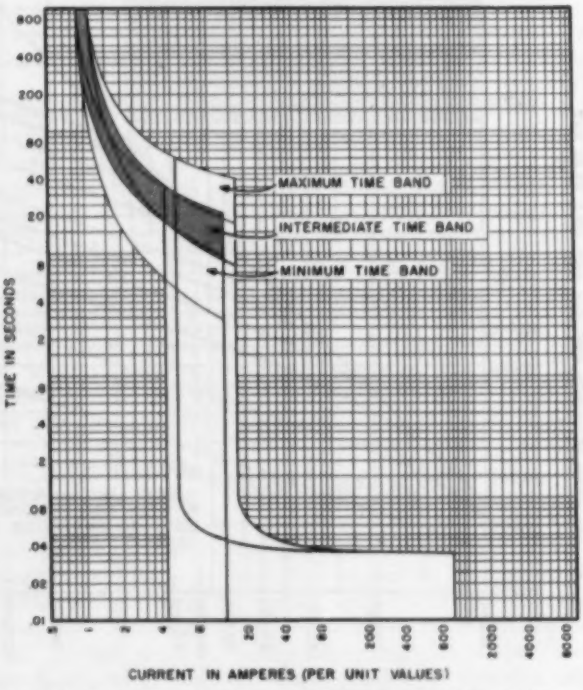


Fig. 2—Typical time-current characteristics of large air circuit breakers showing the time bands available.

large air circuit breakers are given a 30-cycle momentary rating equal to their interrupting rating in amperes. These ratings are satisfactory for the present applications. It could be possible to rate a breaker, both thermally and mechanically, in terms of I^2. The heat developed in a breaker is proportional to the summation of $I^2 \Delta t$ over the time interval during which the current is flowing. The mechanical forces on the breaker parts are proportional to the square of the current at that instant. Momentary ratings obtained with this type of thinking could be higher than those permitted by the present standards.

Fuse-breaker coordination

We have established that current-limiting fuses have three characteristics to evaluate: time-current, peak amperes of let-through current, and $I^2 \Delta t$ let-through values. Air circuit breakers have similar characteristics to evaluate: time-current, ability to withstand peak amperes, and I^2 values. How do we use these characteristics to get a coordinated system? We are primarily interested in the fault current range in this coordination. If the short-time coordination can be obtained, the long-time coordination is easily achieved.

It is possible to select a fuse whose melting-time curve crosses the breaker instantaneous curve at a current value equal to the interrupting rating of the breaker, as shown in Fig 3. This fuse is presumably the one that will permit the breaker to do its duty to the limit of its own capacity without damage to the fuse, and will melt on currents above the breaker interrupting capacity without allowing damage to the breaker. The take-over point should be 18 percent above the interrupting rating of the breaker.

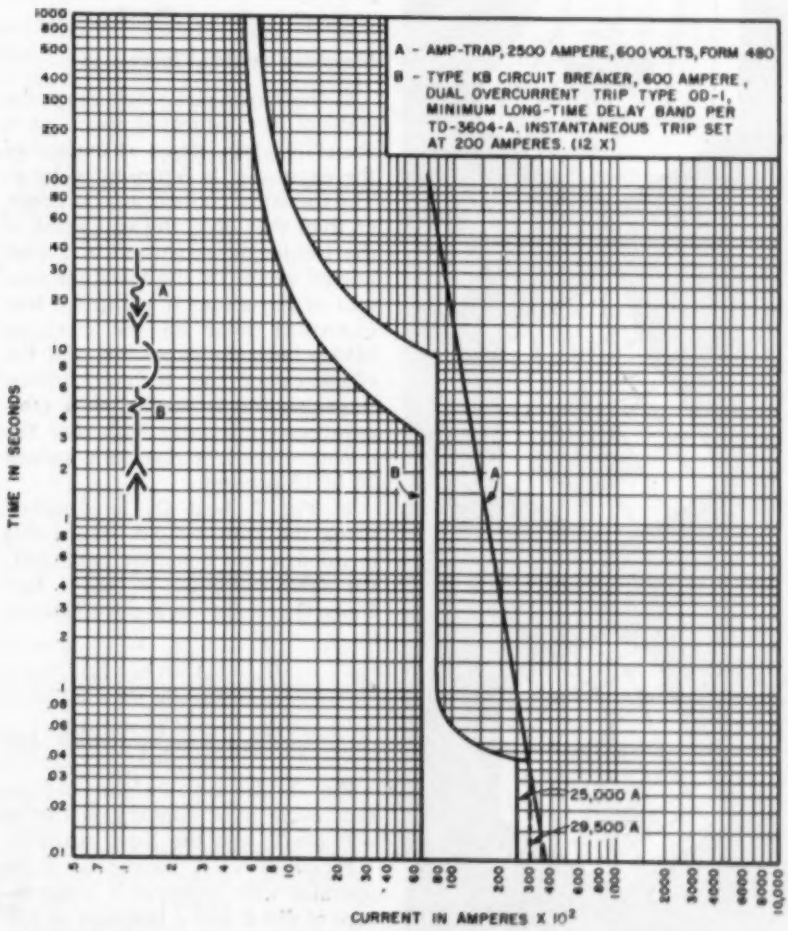

A - AMP-TRAP, 2500 AMPERE, 600 VOLTS, FORM 480
B - TYPE KB CIRCUIT BREAKER, 600 AMPERE, DUAL OVERCURRENT TRIP TYPE OD-1, MINIMUM LONG-TIME DELAY BAND PER TD-3604-A, INSTANTANEOUS TRIP SET AT 200 AMPERES. (12 X)
TIME IN SECONDS
CURRENT IN AMPERES X 10²
25,000 A
29,500 A

Fig. 3—Time-current characteristics of circuit breaker coordinated with current-limiting fuse. Fuse melts on currents above breaker interrupting capacity.

This does not yet determine the peak let-through amperes, so this value must be checked. It can be taken from the curves (page 63). If the value of let-through current exceeds the momentary rating of the breaker, fuse of lower value should be checked.

A fuse could be selected such that the peak let-through amperes (based on the short-circuit current available) do not exceed twice the interrupting rating of the circuit breaker. Considering a fuse selected in this manner, plot the melt-time characteristics (from Fig. 1) against the breaker time-current curve to check coordination. This method is quicker since it immediately takes into account the momentary rating limit of the breaker. The time-current and peak let-through current methods are complementary to each other.

Application of air circuit breakers to distribution systems can be divided into these categories:

¶ Where the main and all feeder breakers are applied within their interrupting ability;

¶ Where the main circuit breaker is applied within its interrupting ability and the large air feeder breakers are in cascade;

¶ Where circuit breakers are applied without regard to interrupting capacity.

Study your system

It is in this last category that plant engineers have begun to realize the carelessness with which a distribution can be originally planned or grow. In old systems, a current-limiting fuse added to the existing feeder circuit breakers can provide the necessary interrupting capacity. In a new system, a study can be made to recommend where current-limiting fuses could be used for the best economic advantage.

Readily acknowledged places where the coordinated fuse-breaker combination can be used are:

¶ In a panelboard to protect the main circuit breaker.

¶ Ahead of a feeder circuit breaker feeding a single load.

¶ Ahead of the main circuit breaker of a switchgear assembly having no other source of power.

For more complicated systems, an analysis of the complete system should be made before recommendations can be given.

A Thermodynamics Refresher — V

The Reheat Cycle

JOHN F. LEE
Professor of Mechanical Engineering
North Carolina State College

I&P EXCLUSIVE

Start right here to review thermodynamics. Each article in this easy-to-read series stands as a story complete in itself. Single copies of this month's Thermo Refresher, as well as single copies of previous articles in the series, are available to readers without charge.

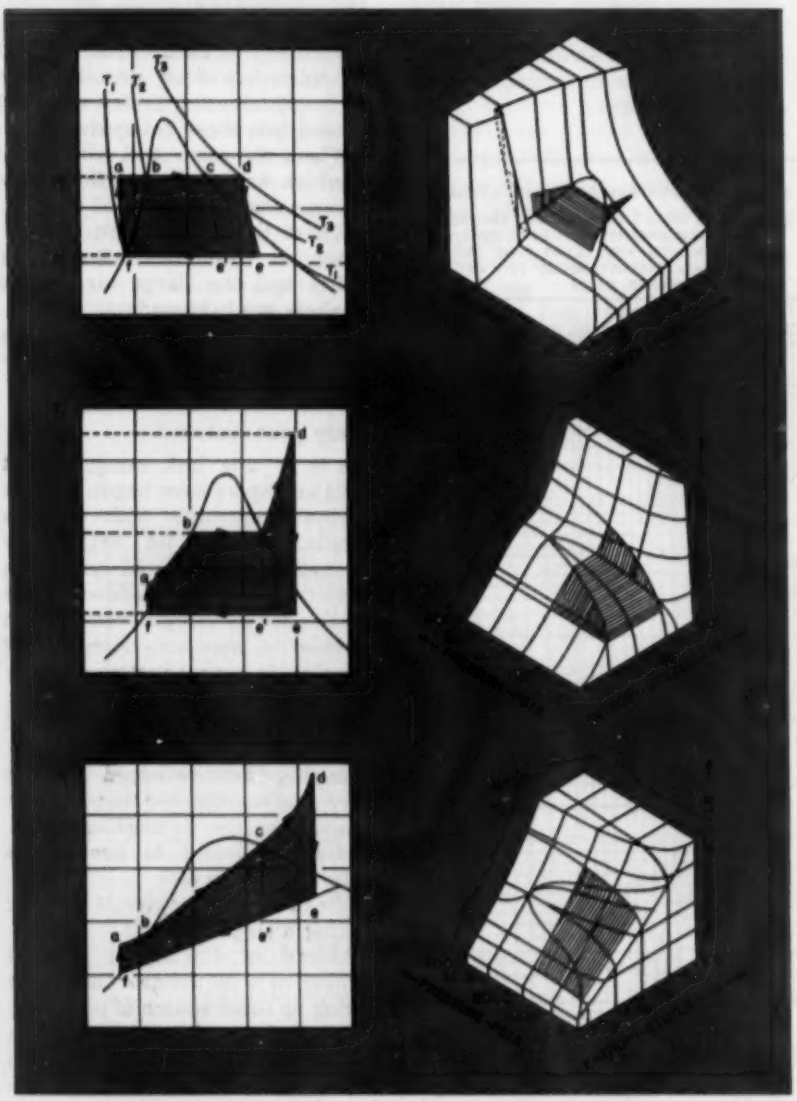


Fig. 1 — Rankine cycle with superheat on p-v-T, s-p-T, and h-s-p surfaces.

IN PRACTICALLY all steam power plants, the steam is superheated to a temperature higher than that of saturated steam before it is expanded in the turbine. (Superheating is represented by the lines *cd* in Fig. 1, where T_s is the temperature of the superheated steam.)

There are three reasons for superheating. First, remember that the Rankine cycle and the Carnot cycle both suffer from the fact that the critical temperature of steam is 705.4 F. Superheating improves on these cycles by raising the highest temperature of the cycle to almost 1150 F, without a corresponding increase in pressure. Second, superheating raises the mean effective temperature at which heat is added, resulting in a corresponding increase in thermal efficiency. Third and most important, superheating permits steam expansion to take place substantially in the vapor region. This may be seen from an examination of Fig. 1.

Moisture content increases

If the expansion starts from the state of dry saturated steam at *c*, the state of the steam at the end of the expansion is represented by *e'*. The moisture content at *e'* is greater than that at *e*, the end point of the isentropic expansion of superheated steam. If the moisture content of the steam is too great, mechanical wear on the turbine blades becomes excessive, and the efficiency of the turbine suffers. Superheating is carried to a temperature sufficiently high that the moisture content does not exceed 10 to 12 percent.

In Fig. 1, heat Q_A is absorbed along the path *a-b-c-d*. Since this is isobaric (at constant pressure), we again have $Q_A = (h_d - h_a)$. Since $Q_R = (h_e - h_f)$, the efficiency is

$$\text{eff}_{th} = \frac{(h_d - h_a) - (h_e - h_f)}{(h_d - h_a)} = \frac{(h_d - h_e) - (h_a - h_f)}{(h_d - h_a)} \quad (1)$$

Fig. 1 also shows the superheat cycle as it appears on the p-v-T, c-p-T, and the h-s-p surfaces.

EXAMPLE 1. A superheat cycle operates with steam at a temperature of 600 F and a pressure of 600 psia, rejecting heat at a temperature of 600 F. Determine the ther-

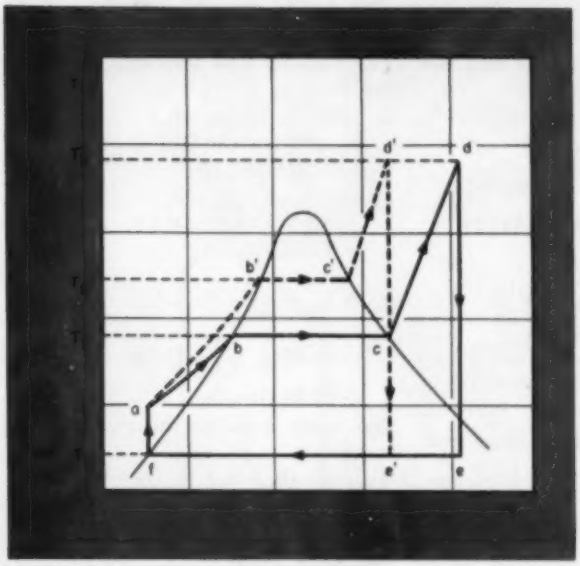


Fig. 2—Raising vaporization pressure increases efficiency (Rankine or superheat cycle) as shown on T-s diagram.

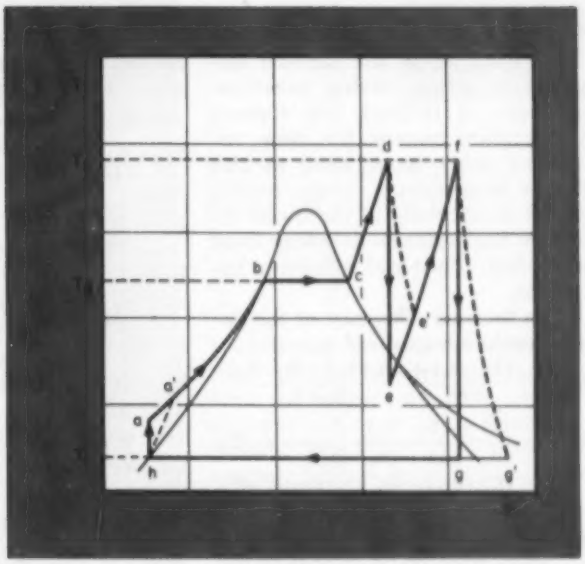


Fig. 3 — Reheat cycle is solution to problem of temperature and moisture content limiting vaporization pressure.

mal efficiency and the ratio of turbine work to pump work when (a) all processes are reversible and (b) when the internal engine efficiency of the turbine and the pump are 0.80 and 0.92 respectively.

(a) From Fig. 1 and the steam tables, we obtain

$h_d = 1289.9$ Btu/lb and

$s_e = s_d = 1.5323$ Btu/lb-F

$$x_e = \frac{1.5323 - 0.0555}{2.0393}$$

$$= 0.724$$

$$h_e = 1088.0 - (1 - 0.724)\ (1059.9)$$

$$= 796 \text{ Btu/lb}$$

$h_f = 28.06$ Btu/lb

$p_a = p_d = 600$ psia

$p_f = 0.2563$ psia

$v_e = 0.01604$ cu ft/lb

The turbine and pump work is

$$W_{turb} = h_d - h_e = 1289.9 - 796$$

$$= 493.9 \text{ Btu/lb}$$

$$W_{pump} = \frac{v_f\ (p_a - p_f) \times 144}{778}$$

$$= \frac{0.01604\ (600 - 0.2563)\ (144)}{778}$$

$$= 1.78 \text{ Btu/lb}$$

The work ratio is

$$\frac{W_{turb}}{W_{pump}} = \frac{493.9}{1.78} = 278$$

which should be compared with the work ratio for a comparable Rankine cycle (103.5).

The enthalpy of the water leaving the pump is

$$h_a = h_f + W_{pump} = 28.06 + 1.78$$

$$= 29.84 \text{ Btu/lb}$$

and the heat added is

$$Q_A = h_d - h_a = 1289.9 - 29.84$$

$$= 1260.1 \text{ Btu/lb}$$

The thermal efficiency is

$$eff_{th} = \frac{W_{turb} - W_{pump}}{Q_A}$$

$$= \frac{493.9 - 1.78}{1260.1} = 39\%$$

(b) Taking the efficiencies $eff_{et} = 0.80$ and $eff_{ep} = 0.92$ into account, we get

$$h_e' = h_d - eff_{et}\ (h_d - h_e)$$

$$= 1289.9 - 0.80\ (493.9)$$

$$= 894.9 \text{ Btu/lb}$$

(The subscript e' refers to the actual conditions leaving the turbine and not *e'* of the figure.)

$$h_a' = h_f + \frac{1}{eff_{ep}}(h_a - h_f)$$

$$= 28.06 + \frac{1}{0.92}(1.78)$$

$$= 29.99 \text{ Btu/lb}$$

The work done in the turbine and pump is

$$W_{turb} = (h_d - h_e') = 395 \text{ Btu/lb}$$

$$W_{pump} = (h_a' - h_f) = 1.93 \text{ Btu/lb}$$

The ratio is

$$\frac{W_{turb}}{W_{pump}} = \frac{395}{1.93}$$

$$= 204$$

The heat added is

$$Q_A = h_d - h_a' = 1289.9 - 29.99$$

$$= 1260 \text{ Btu/lb}$$

and the thermal efficiency is

$$eff_{th} = \frac{W_{turb} - W_{pump}}{Q_A}$$

$$= \frac{395 - 1.93}{1260} = 32\%$$

The reheat cycle

The mean effective temperature at which heat is added in a Rankine or superheat cycle is raised most easily by simply increasing the vaporization pressure. It is clear from Fig. 2, however, that the increased thermal efficiency realized by raising the mean effective temperature at which heat is added may be largely nullified by expansion in the two-phase region.

This problem could be easily solved if the cycle were not limited to a top temperature of 1150 F. To remain within safe values of moisture content and yet not exceed the metallurgical limit on the highest temperature, the vaporization pressure cannot be much in excess of 1400 psia for a direct expansion of the steam from boiler to condenser.

A solution is shown in Fig. 3. Steam is superheated to point *d*, allowed to expand in a turbine to point *e*, then returned to another superheater (resuperheater) located in the boiler. It is superheated again to the same high temper-

ature, and again expanded in a turbine to point g.

At no time is the turbine exposed to steam having excessive moisture. Although the highest temperature remains the same, reheating adds more heat in the higher temperature range—resulting in an increase in the mean effective temperature at which heat is added. Thermal efficiency increases.

The thermal efficiency of the reheat cycle is expressed as

$$\text{eff}_{th} = \frac{(h_d - h_s) + (h_f - h_e) - (h_g - h_h)}{(h_d - h_s) + (h_f - h_e)}$$

$$= \frac{(h_d - h_e) + (h_f - h_g) - (h_s - h_h)}{(h_d - h_s) + (h_f - h_e)} \quad (2)$$

The increase in thermal efficiency by reheating alone is very small, but the increase in thermal efficiency realized by increasing the vaporization pressure to a high level is significant. Reheating is unjustifiable economically when vaporization pressure is below 1400 psia.

EXAMPLE 2. The superheat cycle in Example 1 is modified to include reheat. Steam is withdrawn from the turbine at a pressure of 200 psia and is reheated to 600 F. Determine the thermal efficiency and the ratio of expansion work to pump work when (a) all processes are reversible and (b) when the internal engine efficiency of the turbine and pump are 0.80 and 0.92 respectively. From Fig. 3 and the steam tables we obtain

(a) $h_d = 1289.9$ Btu/lb and

$s_d = s_e = 1.5323$ Btu/lb-F

$$x_e = \frac{1.5323 - 0.5435}{1.0018} = 0.988$$

$h_e = 1198.4 - (1 - 0.988)\ (843.0)$
$= 1188.3$ Btu/lb

$h_f = 1322.1$ Btu/lb and

$s_f = s_g = 1.6767$ Btu/lb-F

$$x_g = \frac{1.6767 - 0.0555}{2.0393} = 0.795$$

$h_g = 1088.0\ (1 - 0.795)\ (1059.9)$
$= 871$ Btu/lb

The work done in the pump and turbine is

$W_{pump} = 1.78$ Btu/lb

$W_{turb} = (h_d - h_e) + (h_f - h_g)$
$= (1289.9 - 1188.3) + (1322.1 - 871)$
$= 552.7$ Btu/lb

The work ratio is

$$\frac{W_{turb}}{W_{pump}} = \frac{552.7}{1.78} = 311$$

$Q_A = (h_d - h_s) + (h_f - h_e)$
$= (1289.9 - 29.84) + (1322.1 - 1188.3)$
$= 1393.9$ Btu/lb

$$\text{eff}_{th} = \frac{W_{turb} - W_{pump}}{Q_A} = \frac{552.7 - 1.78}{1393.9} = 4\%$$

Considering the efficiencies of the turbine and pump,

(b) $\text{eff}_{et} = 0.80$ and $\text{eff}_{ep} = 0.92$ we find

$h_e' = h_d - \text{eff}_{et}\ (h_d - h_e)$
$= 1289.9 - 0.80\ (101.6)$
$= 1207.6$ Btu/lb

$h_g' = h_f - \text{eff}_{et}\ (h_f - h_g)$
$= 1322.1 - 0.80\ (451.1)$
$= 961.2$ Btu/lb

$$h_s' = h_h + \frac{1}{\text{eff}_{ep}}(h_s - h_h)$$

$$= 28.06 + \frac{1}{0.92}(1.78)$$

$= 29.99$ Btu/lb

The work done in the pump and turbine is

$W_{turb} = (h_d - h_e') + (h_f - h_g')$
$= 443.2$ Btu/lb

$W_{pump} = h_s' - h_h = 1.93$ Btu/lb

The work ratio is

$$\frac{W_{turb}}{W_{pump}} = \frac{443.2}{1.93} = 229$$

$Q_A = (h_d - h_s') + (h_f - h_e')$
$= 1260 + 114.5 = 1374.5$ Btu/lb

$$\text{eff}_{th} = \frac{W_{turb} - W_{pump}}{Q_A} = \frac{443.2 - 1.93}{1374.5} = 32\%$$

Next month: Another article in INDUSTRY & POWER'S Thermodynamics Refresher. Prof. Lee will discuss "The regenerative cycle."

Quick estimation for demineralizer operating costs

THREE BASIC methods can be used for demineralizing, depending on the composition of the raw water and the degree of purity required in the treated water. The two-bed demineralizer with a weak base anion exchanger offers lowest operating cost but doesn't remove silica. The two-bed demineralizer with strong base anion exchanger almost completely removes silica and carbon dioxide. The mixed-bed demineralizer, which removes silica, is most useful when high-quality treated water is desired.

Once a demineralizing system has been chosen, its operating costs can be estimated by using the chart and a few simple calculations:

¶ Obtain an analysis of the raw water and express all constituents in ppm as Ca CO_3.

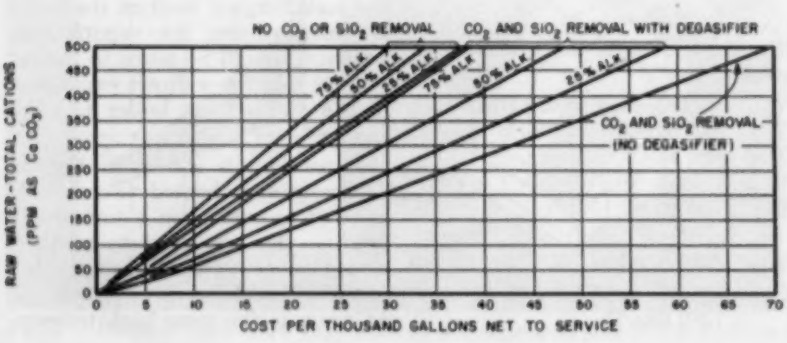
¶ From the analysis, obtain the total cations (in ppm as Ca CO_3). This is the sum of the Ca, Mg, and Na.

¶ Obtain the methyl orange alkalinity (in ppm as Ca CO_3).

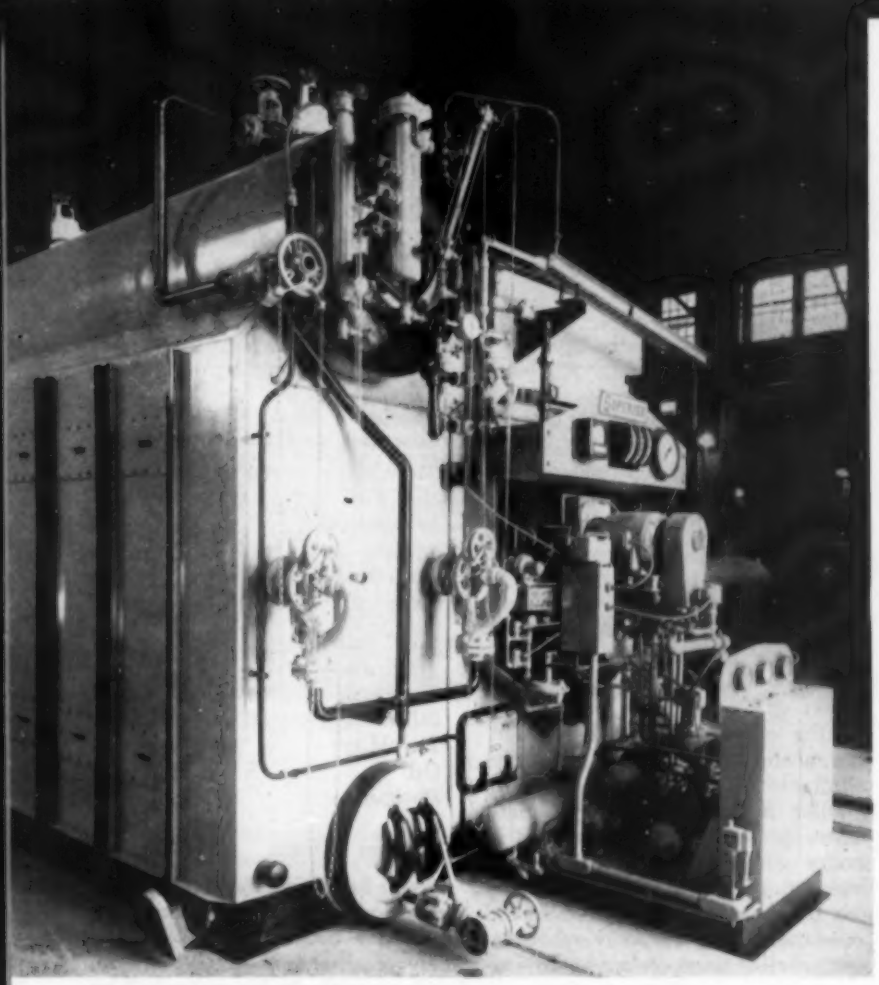
¶ Calculate the percent alkalinity.

$$\frac{\text{(Methyl Orange Alkalinity x 100}}{\text{Total Cations}} = \text{Percent Alkalinity}$$

After choosing the treatment to be used, locate on the chart the intersection of the lines of total cations and percent alkalinity. Then read down to find the chemical operating cost in cents per 1000 gallons of net water to service. The figures on the chart are based on average chemical costs, and are subject to normal price variation.



—Lenord Limon, Manager
Industrial and Boiler Feed Dept.
Graver Water Conditioning Co.



FRANK E. HOHNHOLT
Manager Water Tube Boiler Division
Superior Combustion Industries

Mr. Hohnholt has been connected with the water tube package boiler industry since its inception in 1946. He was educated at Cooper Union, Mechanics Institute, and CCNY. A professional engineer licensed in the State of New Jersey, Hohnholt is a past national director of the National Society of Professional Engineers. He is a member of ASME, Society Naval Architects and Marine Engineers, and the National Society of Power Engineers.

After fire test in manufacturer's plant, 15,000-pound-per-hour water-tube package boiler is ready for shipment.

I&P EXCLUSIVE

How to specify a WATER-TUBE package boiler

HOW MANY TIMES have you been in on the purchase of a boiler that was selected wholly on the basis of its heating surface? Perhaps during your discussions, the problem was expanded to consider the base loading in relation to total heating surface and possible overload ratings with specific fuels.

Back in the good old days when the HRT boiler was the unit most often used to generate steam, this caliber of analysis did not present too many hazards. Total boiler capacities were small, pressures were low, and evaporation rates were conservative. But today, selection by quantity of heating surface or furnace volume is not enough.

A properly designed package water-tube boiler, within its rated steam producing capacity, should be as efficient as a field-erected boiler. It should require no more service or maintenance, and should have an equal availability factor and service life. As a matter of fact, many package water-tube boilers are exceeding the performance of field-erected boilers at lower maintenance costs. However, not all of them do qualify in this respect. Standards are often lowered in order to produce a product at a price. Engineering companies, under pressure of reduced budgets, are being forced to approve cheap substitutes not originally specified. This policy is false economy.

The difference in original cost between a properly designed unit and one produced at a price is frequently offset during the first or second year of operation by high maintenance costs, which continue for the life of the installation. High maintenance costs may arise from any one or all of these factors:

¶ So-called package firing equipment that is nicely boxed for appearance but that creates difficult maintenance problems.
¶ Small burners, or not enough burners, with high draft losses and increased fan power factor.
¶ Large capacity boilers with single burners and flame impingement that may result in tube loss or frequent shutdown for scale removal.
¶ Inadequate refractory and insulation, particularly in the boiler side wall furnace area.
¶ Improperly mounted forced draft fans that cause flame distortion.
¶ Single manhole opening in long and small diameter drums. This provides little ventilation, which lengthens shutdown time and increases service costs.
¶ Openings in casings inadequate for tube bank inspection.
¶ No furnace access door.
¶ No bypass around feedwater regulator.
¶ Automatic gas firing with intermittent ignition and unsafe automatic fuel shutoff valves.
¶ Swaged tubes and small diameter steam drums (sometimes found together). When, and if, swaged tubes are used, they should be preferably in the furnace.

To reduce maintenance and protect your investment, insist upon your package boiler being fire tested at actual operating conditions in the manufacturer's plant before shipment.

Terminology

Boiler horsepower may be defined in three ways: 1 horsepower equals 10 square feet of boiler heating surface, or 34.5 pounds of steam per hour from and at 212° F, or 33,500 Btu's per hour output. Undoubtedly, the heating surface definition is something that has been carried on from the days of the old fire-tube, brick-set, hand-fired HRT boiler. With the introduction of modern boilers, use of liquid and gaseous fuels, and (more recently) the acceptance of package water-tube boilers, this form of rating no longer applies.

Unfortunately, many engineers, (including consulting engineers who are writing specifications) continue to use the confusing expression "horsepower." Little is gained in using this expression, even indicating which of the three definitions the engineer has in mind —then specifying that the boiler shall be operated not in excess of some percent of nominal rated capacity. This practice does not take into consideration advantages of one design over another.

Expressing boiler horsepower on the basis of 34.5 pounds of steam per hour from and at 212° F is also of little value when we recall that all boilers are not operated at one pressure or final steam temperature. Actual heat content of a pound of steam will vary with pressure and superheat conditions.

Expressing boiler horsepower in terms of Btu output per hour is the most sensible approach to expressing the capacity of a boiler at some given pressure and final steam temperature. Undoubtedly, this definition will eventually be adopted by the engineering profession. In the meantime, we should definitely eliminate the use of the expression "boiler horsepower." Many engineers presently are specifying a boiler capacity by indicating the generating rate in pounds of steam per hour output at required steam conditions. This is a reasonable compromise until we agree to express boiler capacities in Btu per hour output.

Limitations on boiler capacity

Capacity of a water-tube package boiler is limited by many factors. Some are common knowledge, and others are often completely overlooked or are not sufficiently understood. The result is selection and installation of oversized or undersized steam generating equipment. Of prime importance in sizing a water-tube boiler, (and in particular a package water-tube boiler) include water quality, circulation, steam drum design, furnace volume, and heating surface.

All water requires some form of treatment before it is suitable for boiler feed. Chemicals must be added to adjust alkalinity and prevent formation of scale. Boiler capacity can be limited by the formation of scale in the tubes and by the requirement of excessive blowdown to maintain concentrations. In addition, the effect of solids on boiler water level, foaming, priming, and so forth further limit the unit's ability to provide dry steam.

Selection of equipment for boiler feedwater treatment should always be placed in the hands of a competent feedwater consultant. Water should be treated to make it noncorrosive in the boiler and to prevent formation of scale and excessive accumulation of sludge. It also may be necessary to treat for the removal of organic substances that will cause foaming and excessive water carryover.

Feedwater specifications

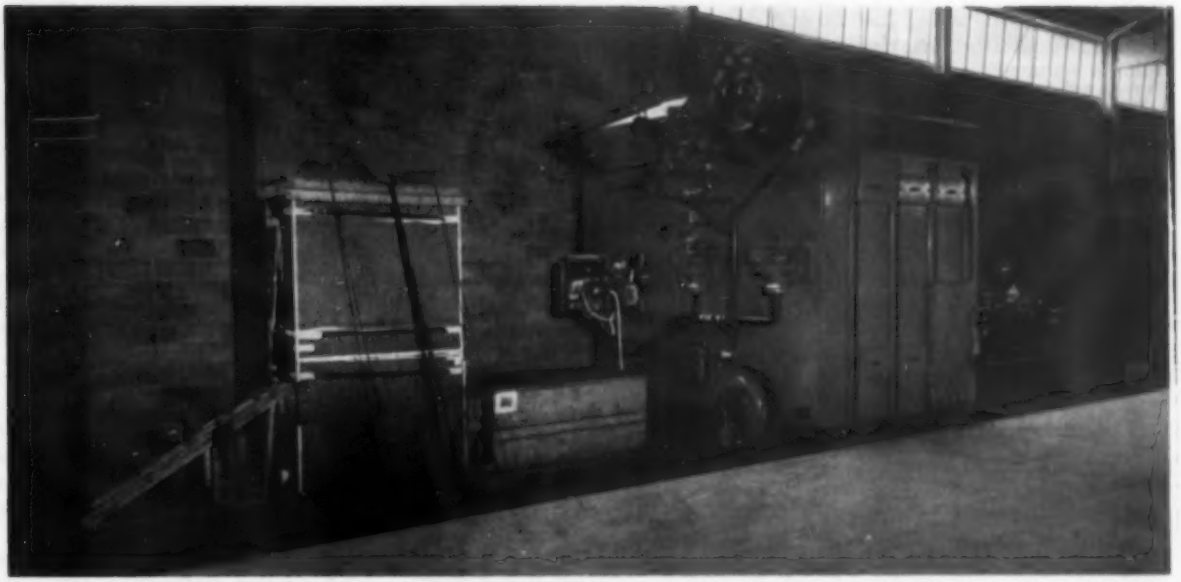
Since the majority of boilers fall within the 100-psi to 300-psi pressure classification, the following limits on concentration of various constituents in the boiler feedwater are recommended:

Total solids:	3500 ppm
Total alkalinity:	700 ppm
Hardness:	0 ppm
Silica:	50 to 100 ppm
Turbidity:	175 ppm
Oil:	7 ppm
Phosphate:	140 ppm
pH:	10.5 to 11.5
Oxygen in feed:	.040 cc/l

These limits, except oxygen concentration, pertain to the boiler water. By maintaining the phosphate residual from 40 to 140 ppm, hardness in the boiler water will be reduced to zero. The phosphate will combine with any calcium that remains after external feedwater treatment. By maintaining sufficient alkalinity to give a pH value between 10.5 and 11.5, all the magnesium still present in the feed will be precipitated as magnesium hydroxide instead of the more adherent form of magnesium phosphate. In order to keep the silica in soluble form, it is usually recommended that a ratio of 2 to 1 be maintained between the alkalinity and silica.

Deaeration is necessary

Feedwater deaeration is almost always required. Where a good deaerator has been provided, an oxygen scavenger such as sodium sulphite is not necessary. Chemicals required for internal treatment should be added directly to the boiler through a chemical feed line. They should be added continuously, or at least over long periods of time. Shot-feeding of chemicals should be avoided since this may result in chemical excesses that far exceed established limits.



One flatcar holds entire package unit including controls, shown as it arrived at Central Fibre Products Co., Inc. Omaha.

At times, chemical concentrations may fall well below prescribed limits. It is recommended that samples of water be taken at least once a day to determine the total solids by gravimetric analysis or by conductivity measurements.

If these techniques are inconvenient, analysis of feed or boiler water for chlorides will serve as a continuing index for estimating total dissolved solids in the boiler water, but this is not so accurate.

Circulation

The next problem is to determine if the boiler will maintain proper circulation at maximum load (steam generating capacity) for any period of time. Some boilers are designed with headers supplied by feeders, downcomers, or both. Where relatively high absorption rates per square foot of radiant surface exists, overload ratings may be restricted by the arrangement, size, and number of feeders to water-wall headers. At first glance, this feature may appear to be unimportant. Firing rates with gas and oil fuels should be tied to absorption rates per square foot of radiant surface, or average heat-transfer rate through net effective heating surface. Obviously, designs that do not include headers with feeder systems are to be preferred to those that do use them.

To evaluate the quality of steam to be produced, design of the drum and its internals must be investigated. Drum size is very often indicated by diameter only, but steam quality is not determined by drum diameter alone. The area of steam releasing surface, steam space above the water line, and design of internals all contribute to the production of dry steam. An undersize drum with inadequate internals will limit boiler output or produce wet steam and lowered efficiency.

Furnace volume

Some engineers still express limitations on heat releases per cubic foot of furnace volume without giving proper consideration to the type of fuel, the size and arrangement of the furnace shape, and the amount, if any, of water cooling (radiant surface) in the furnace. On the basis of liquid or gas firing, military specifications prepared by the Bureau of Yards and Docks for water-tube package boilers permit a heat release of 54,000 Btu's per cubic foot of furnace volume. This figure may seem high. But where large water-cooled surfaces are involved, it is a conservative figure. This kind of specification imposes limits upon the boiler output. We are primarily interested in the furnace temperature, and the heat absorbed per square foot of radiant surface. This is far more important than the heat released per cubic foot of furnace volume.

We should consider the shape of the furnace (length, width, and height) since the fuel must be fired without impinging upon any of the surfaces. Height is not as important as furnace length, since length provides the room for flame propagation. Of greater importance than an expression of furnace volume is examination of a furnace arrangement as to size, shape, and the amount, type, and spacing of water cooling surface. A properly designed furnace, providing satisfactory temperature, will permit greater firing rates and greater steam production.

Heating surface

Though the total amount of heating surface is important, the design and arrangement of the surface is much more vital. The ratio of radiant surface to convection surface is worthy of serious consideration.

Water-cooled furnace walls made up of 2-inch tubes on 2-inch centers have several advantages over finned-tube construction:

¶ Number of tubes per lineal feet of boiler length is greater.

¶ Furnace tubes are riser tubes. So, with a greater number of riser elements, each tube will be called upon to do less work.

¶ With each tube doing less work, danger of scale forming within the tube is reduced.

Finally, the arrangement of baffles, if required, should be closely studied by the purchaser of steam generating equipment. Baffles can fall into one of two general classifications. One type of baffle may be called a directional gas-flow baffle. The second type may be gas-diffusion baffle. All baffles are used to direct the flow of gases between the inlet and outlet of the tube bank.

Baffles increase heat transfer

Some baffles are employed to reduce the area through which the gases pass to increase the transfer rate. Not all baffles are successful in accomplishing this. Some of the heating surface is sometimes behind baffles where it can do little or no work. With this in mind, the purchaser of a boiler should not depend too much upon the fact that one boiler has more heating surface than another.

It is possible that a boiler with a greater amount of surface may actually have less total efficient, usable surface.

In both package and field-erected boilers where draft and air requirements are produced by fans rather than by the stack, steam output can be limited by the capacity of the burners, or lack of sufficient air to burn fuel properly. Where a fan provides not only the oxygen for combustion but also the power to transmit the gas through the boiler, the size and capacity of the fan is extremely important.

There are many types of fans and burners that can be applied to boilers. Each has its own advantages. Keep in mind that burner register and throat diameter must be sized for total steam generating capacity, regardless of the period of time that this load is maintained.

Burner affects fan capacity

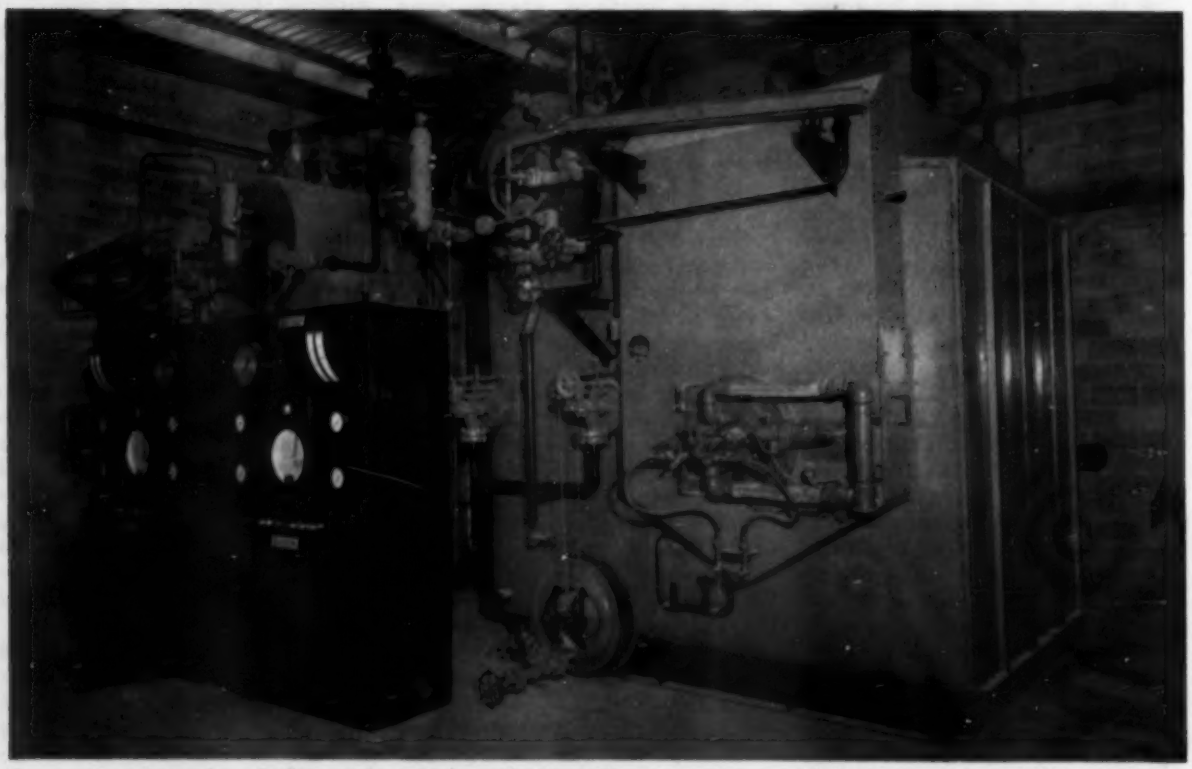
Pressure drop across the burner at a given boiler load has a direct bearing on the static pressure and air delivery capacity of a fan.

Boiler output is limited by the amount of water that can be fed to the boiler since each pound of water injected is converted to a pound of steam. The selection of a feedwater regulator, including the size of its control valve and the boiler feed pumps, can be a limiting factor on boiler output. These two auxiliaries supplement each other, since the proper function of the feedwater regulator depends upon an established pressure drop across its controlling valve and an unfailing supply at constant pressure.

Don't overlook other items

In a general way, several other items such as the size and number of safety valves, and the size of the main steam drum nozzle may also become limiting factors on total output of a boiler.

We have seen that there are poor and indirect methods of determining the size of a boiler. All of the items we have discussed are integral parts of the subject. They must all receive proper consideration if a successful, economical, and low-maintenance boiler installation is to be made.



Two water-tube package boilers, with control panels, fit neatly into one corner of boiler room at Central Fibre Products.

HOW TO BUY RUBBER TRANSMISSION BELT

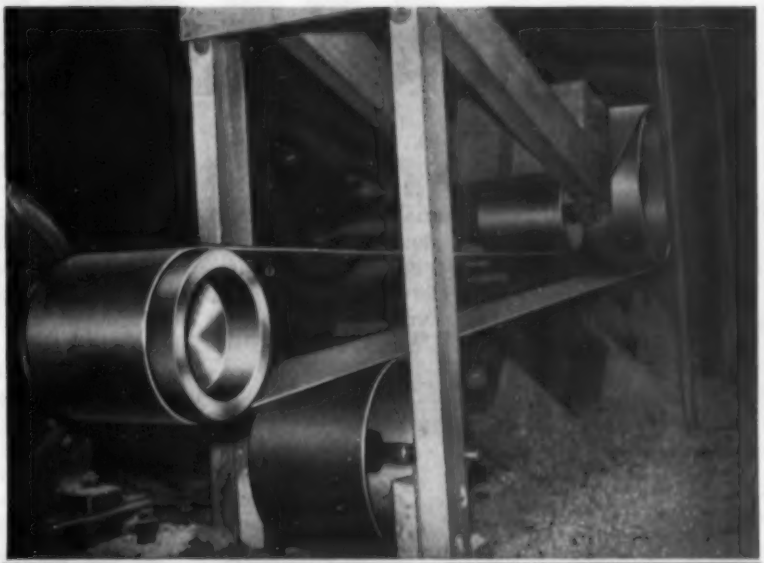
For MORE POWER AND LONGER BELT LIFE

"More Use per Dollar"

Look for a belt engineered to give uniform ply tension and eliminate major causes of premature belt failure.

Unequal distribution of tension among the plies of a rubber transmission belt is the cause of most belt weaknesses and eventual failure. With ordinary belts, the inner plies "loaf", become loosely crumpled when rounding a pulley. Outer plies become overworked . . . pull more than their share of the load. The thicker the belt the greater the tension of these outer plies. It is here where belt failures begin . . . plies separate, outside plies rupture—especially at the fasteners. Where ply stresses are equalized *during manufacture*, every ply pulls its share of the rated horse-power of the belt . . . you get more power, more belt life, longer trouble-free service.

Specify by name the only transmission belt with exclusive equalized ply stresses . . . specify R/M's Condor Compensated Belt.



CONDOR COMPENSATED BELT

An exclusive Manhattan method of equalizing transmission belt ply stresses was developed by R/M engineers especially to eliminate ply separation, rupture and fastener troubles. When Condor Compensated Belt rounds the pulley, every ply is under *uniform* tension . . . every ply pulls its full share of the load. On many drives, Condor Compensated Belt holds fasteners up to 4 times longer than ordinary belt. A selection of driving surfaces is available to meet various machine tension requirements . . . from low-tension to a required degree of slip.

Let an R/M representative show you how the advantages of Condor Compensated Belt can mean more power and longer trouble-free belt life . . . "More Use per Dollar" on your power transmission drives. For endless belts, ask about Condor Whipcord Belts with endless, stretchless cord strength members.

RM 516 F.O.L.

MANHATTAN RUBBER DIVISION—PASSAIC, NEW JERSEY

RAYBESTOS-MANHATTAN, INC.

Other R/M products include: Industrial Rubber • Fan Belts • Radiator Hose • Brake Linings • Brake Blocks • Clutch Facings
Asbestos Textiles • Packings • Engineered Plastic, and Sintered Metal Products • Bowling Balls

Circle 136 on READ-N-CIRCLE card for more data

In brief....

ASME Boston meeting

THE ASME held its semi-annual summer meeting in Boston recently, in conjunction with its Diamond Jubilee celebration. Here are highlights from papers of interest to INDUSTRY & POWER readers.

Effect of bearings on speed of overhung turbines

C. J. Maday
Rossford Ordnance Depot

"The critical speed for a rotating machine usually is calculated only from the mass-elastic characteristics of the system. However, forces which will cause failure of overhung turbine bearings may be produced at steady operating speeds that are considerably below this calculated critical speed. The operating speed can be increased and the vibration decreased mainly by decreasing the bearing clearance and improving the wheel balance.

"These modifications also result in reduced bearing reactions and increased minimum oil-film thickness in the bearing. Performance curves computed for an overhung turbine show that the critical speed, determined only from the elastic properties of the rotor, cannot be used to predict the maximum operating speed of the machine. The bearing eccentricity ratio, the minimum oil-film thickness, and the magnitude of the bearing reactions also must be considered in determining the maximum safe operating speed of the turbine."

Silica carryover in steam

E. E. Coulter
E. A. Pirsh
E. J. Wagner, Jr.
The Babcock & Wilcox Company

Mechanical carryover was measured by a new technique, in which radioactive phosphorus, P^{32}, was added to the boiler water in the form of phosphate, and the amount of tracer material in condensed steam samples was measured. The sensitivity of this method surpasses by far that of any method used previously, and phosphate concentrations in the steam samples could be determined to the nearest one part in ten trillion ppm . . .

"It has been proven that only a negligible part of the silica found in the steam during most test conditions was the result of mechanical carryover. Therefore, the silica was transported selectively by some other mechanism, probably in vaporous form."

Designing the safer factory

R. T. Van Ness, Engineering Department
E. I. du Pont de Nemours & Company, Inc.

"Incorporating safety in design, like safety in any other part of our industrial operations, depends on certain prerequisites.

"1. The safety objectives must be specific and must have the full and whole hearted backing of top management and all supervision. Unless all levels of management and supervision have received safety training over a long period of time and are 'sold' on the value of the effort, it would be impossible to have any kind of effective safety integration in the completed work. Safety is not a matter of rules or exhortations, but a philosophy and insight which must pervade the entire organization.

"2. Safety training must be intelligently conceived and presented, keeping in mind the type of work, education, and responsibilities of the group to be influenced. The program must relate to the employee's own work and experience. It should be developed in such a way that it shows him how he can protect himself and how his efforts can protect others from accidents.

"3. Safety is a continuing program. Constant alertness and analysis are required and, therefore, the program should be varied in order to stimulate and hold the interest of all echelons of employees.

"4. Safety accomplishments must be measured on both a humanitarian and an economic basis. The elimination of personal injuries alone warrants our best efforts but, quite apart from the obvious humanitarian side, the industrial safety program is also spurred by the realization that safety is a sound business investment. In our industrial life humanitarian and economic interests are inseparable.

"5. Promotion of safety cannot be left to people who are misfits in other jobs. To obtain good results requires capable, imaginative, and enthusiastic people to be the motivating force in the program.

"6. Safety programs should aim at the elimination of *all* injuries not simply at reducing accidents. . . ."

Flame geometry

R. C. Le May
Selas Corporation of America

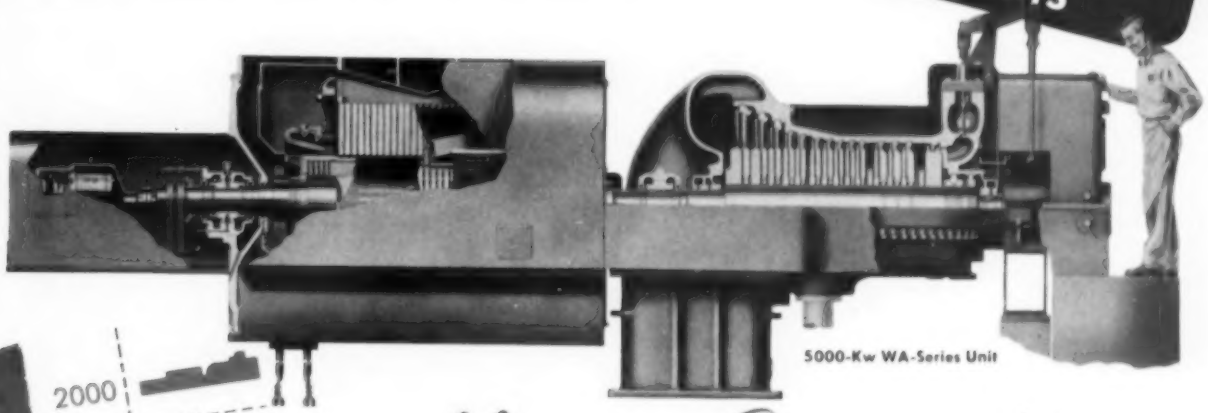
"The usefulness of fuels can be and is now being increased by employing additional controls beyond those normally exercised in typical 'heat liberations'. These additional controls are directed largely toward influencing flame geometry, and through this to the more effective heat transfer required by modern industry. . . .

"In varying degrees, control of flame geometry has been employed to increase the usefulness of all fuels, and it is believed that more precise control will further increase the usefulness of each. To date, however, it is the gas-fired processes which have most extensively and effectively utilized the deliberately shaped flame. . . ."

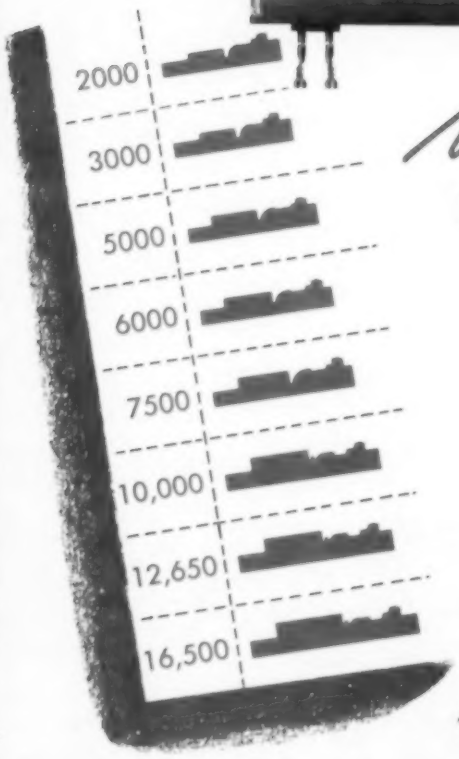
Now

WA-Series Extended To 16,500 Kw

WA-Series STEAM TURBINE GENERATOR UNITS



5000-Kw WA-Series Unit



Modern, Compact Units meet wider plant needs

Now you can get WA-Series steam turbine-generator units in new, higher ratings. Already operating across the country in NEMA ratings from 2000 to 7500 kw, these completely modern units are now available in AIEE-ASME preferred ratings to and including 16,500 kw.

WA-Series steam turbine-generator units provide power only or power as a by-product of process steam. They are attractive, compact units that have many of the "big turbine" features for which Allis-Chalmers is famous.

For example, the accurate, reliable centrifugal speed governor is the same type used in large Allis-Chalmers steam turbines. Steam seals are the same trouble-free labyrinth type used in turbines up to 300,000 kw.

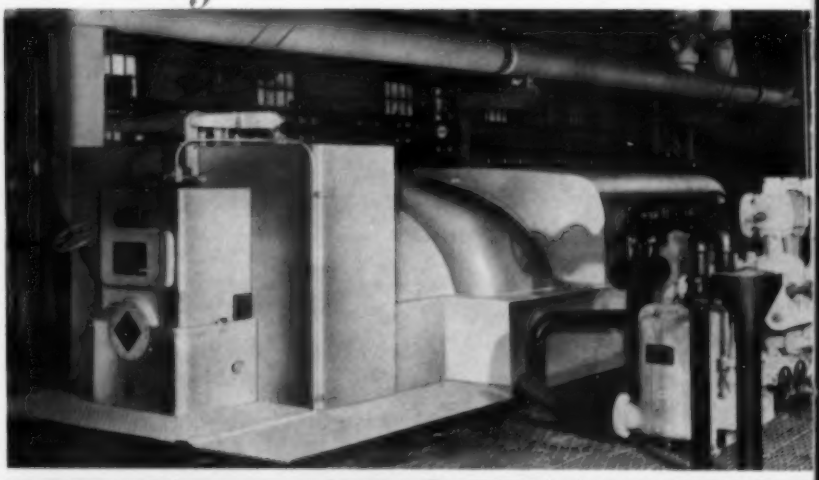
For information on application of these modern, economical generating units, turn the page.

A-4810

ALLIS-CHALMERS

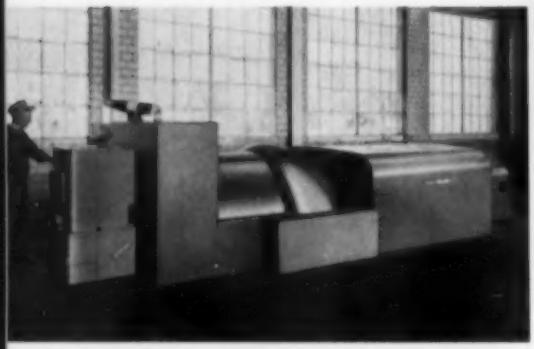
For Modern Power

MANUFACTURING PLANT in Wisconsin uses this 7500-kw automatic extraction condensing unit in its power house. WA-Series unit generates power as by-product of process steam.



MINING OPERATION in Southwest gets power from a 5000-kw condensing unit. Waste heat from reverberatory furnaces is used for generating steam.

PAPER MILL in Wisconsin uses this 5000-kw non-condensing WA-Series unit to obtain both power and process steam for paper manufacturing. Photo at right shows generator end of unit.



UTILITY SERVICE in Ohio is provided by 3000-kw condensing WA-Series steam turbine generating unit.

ALLIS-

Plants Everywhere

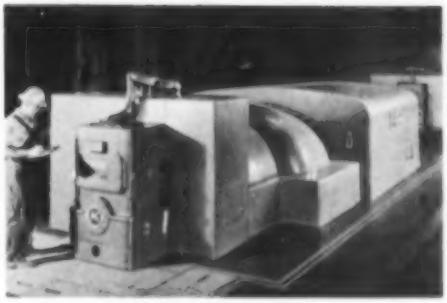
● Installations throughout the country are proving the low installation and operating costs of modern WA-Series steam turbine-generator units.

Maximum simplicity is assured by three-bearing construction. A bracket-bearing, housing type air-cooled generator is used for smaller units. A hydrogen-cooled generator is used for 16,500-kw units. Basic engineering features include labyrinth steam seals throughout, removable external glands, high chrome alloy steel buckets and nozzles and a time-proved governing system.

Installation is simplified because WA-Series units are factory assembled, and shipped on a single flatcar. Turbine and generator rotors are individually locked securely in place. All manufacturing and testing takes place in a single plant.

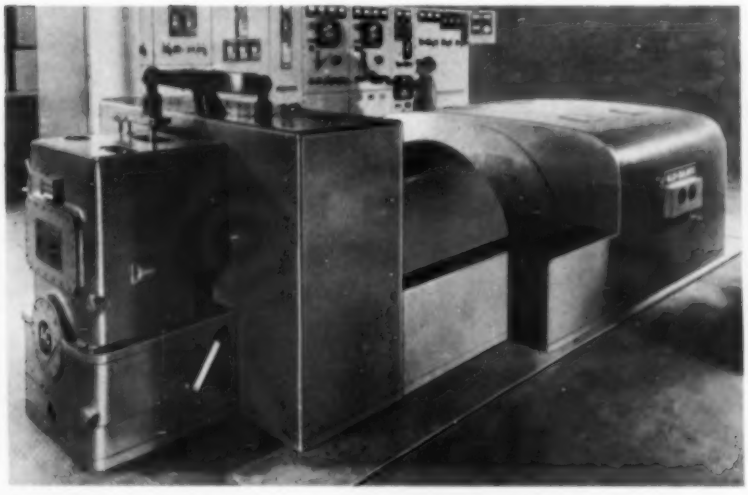
Foundation cost is reduced because oil piping and generator air coolers are above the floor line.

To get more facts on these economical units, call the nearest A-C district office or write Allis-Chalmers, Milwaukee 1, Wisconsin for Bulletin 03B7654.

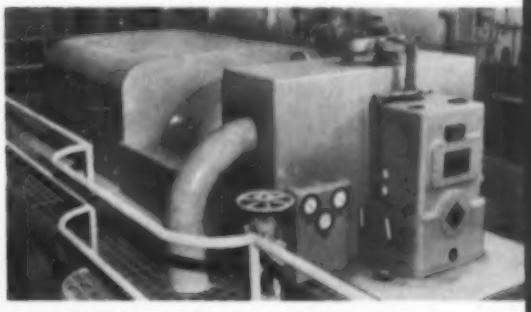


CHEMICAL OPERATION in Illinois uses two 5000-kw automatic extraction condensing units which generate power as by-product of process steam needs.

UTILITY in Florida uses two 5000-kw condensing WA-Series units to supply power for consumer needs.



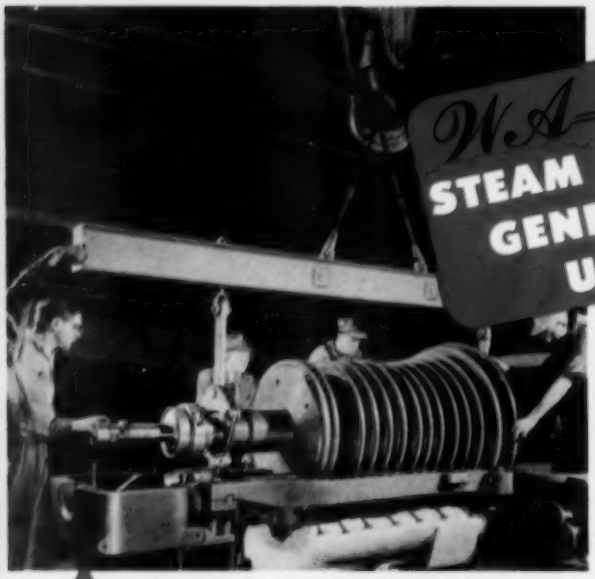
GRAIN PROCESSING in Wisconsin requires power and vast quantities of process steam 24 hours a day, 7 days a week. A 2500-kw non-condensing unit supplies power as by-product from process steam.



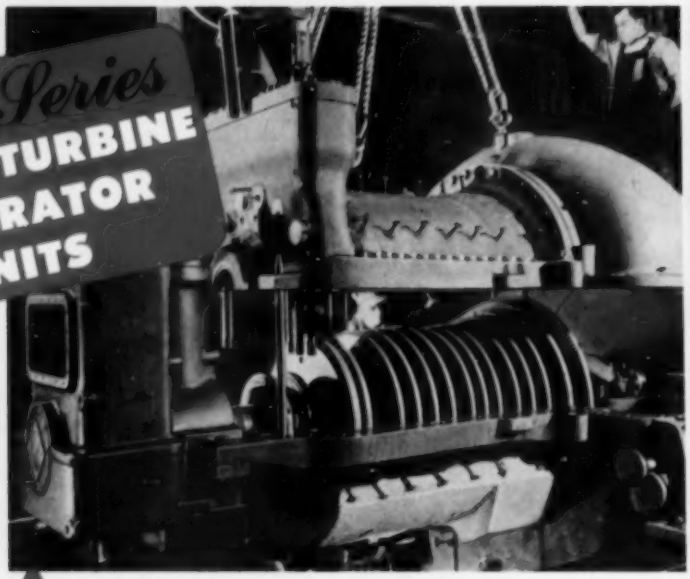
CEMENT PLANT in Kentucky obtains electric power from a 5000-kw condensing WA-Series unit. Steam is produced with waste heat from kilns.

CHALMERS

A-C ALLIS-CHALMERS



W.A.-Series STEAM TURBINE GENERATOR UNITS

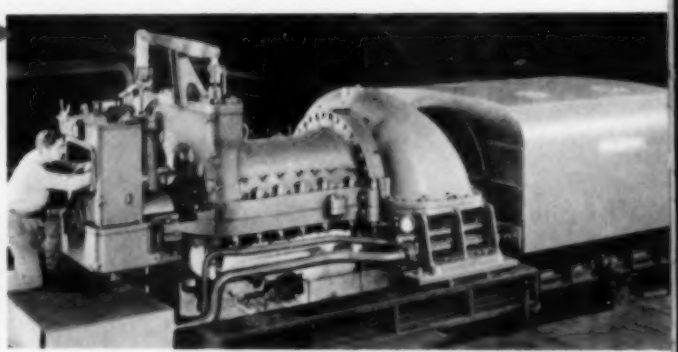


▲ Above: Precision balanced turbine rotor is lowered into casing during manufacture of a WA-Series steam turbine generator unit. One example of the quality designed into these units: all wheels have durable chrome alloy steel buckets.

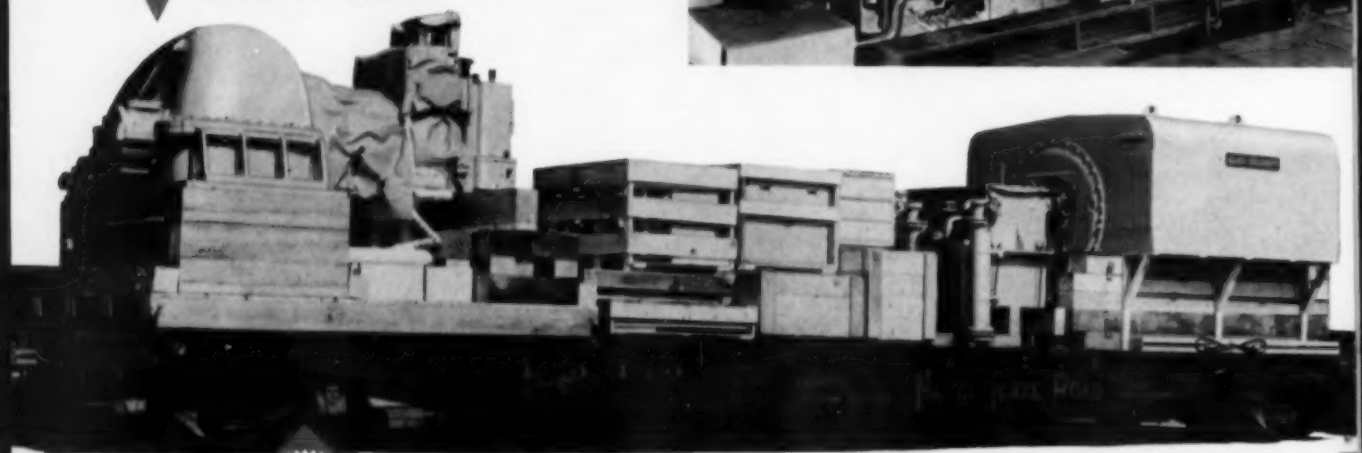
▲ Next step in assembly is addition of upper half of the turbine casing. WA-Series units provide the benefits of more than 50 years of Allis-Chalmers experience in designing and manufacturing steam turbine generating equipment.

Precision Built
For Fast Installation

Assembled 3-bearing unit—complete with housing type generator — is factory tested. Both oil piping and generator gas coolers are above the floor line, simplifying installation and service.



An entire WA-Series unit—pretested and insulated—is loaded on a single flatcar for shipment. Both turbine and generator are shipped with their rotors locked securely in place. Below, a 7500-kw unit in transit.



A-C ALLIS-CHALMERS

ALLIS-CHALMERS

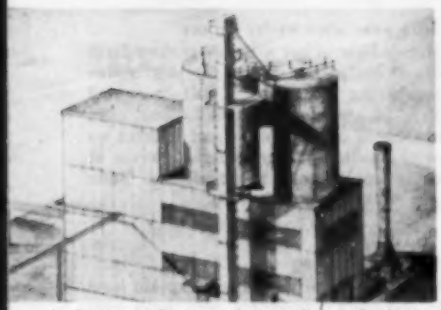
Milwaukee 1, Wisconsin

DUPONT'S Barksdale, Wis. Works saves $7,000 a year with new automatic combustion controls.

HUDSON MOTORS' modernized plant in Detroit saves $480,000 a year—cuts powerhouse labor 27%.

SYRACUSE UNIVERSITY, N. Y., built a completely new unit for maximum economy and dependability.

For efficiency... for economy...



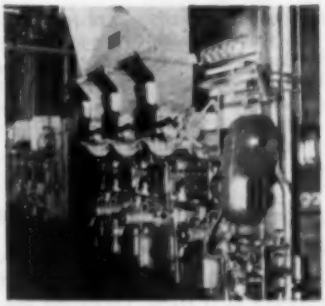
AT STAUFFER CHEMICAL'S new plant in Louisville, Ky., total cost of steam is only 60¢ per 1,000 lbs.

Coal costs 29.6% less than next cheapest fuel at ADDRESSOGRAPH-MULTIGRAPH'S plant in Cleveland.

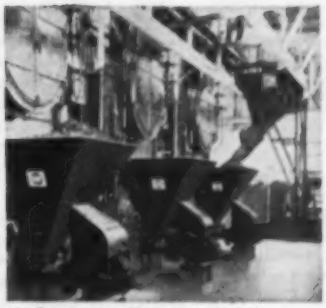
MOTOR PRODUCTS CORP. of Detroit, Michigan, saves $54,000 a year with modernized installation.

more and more firms

Burning coal the modern way saves PENNSYLVANIA RAILROAD'S, Ft. Wayne, Ind. terminal $33,000 a year.



Efficient new equipment reduces labor and improves performance records for LIGGETT & MYERS at Richmond, Va.



At LAKEWOOD HOSPITAL, in Lakewood, Ohio, new automatic coal burning facilities cut fuel costs 22%.

UPJOHN'S new Kalamazoo, Mich. plant is clean and efficient with no dust or smoke nuisances.

are burning coal the modern way

Chicago's ultra-modern PRUDENTIAL BUILDING has fully automatic coal handling and burning system.

GOODYEAR saves $3,000 a day with new coal-burning installation at Akron, Ohio.

facts you should know about coal

- In most industrial areas, bituminous coal is the lowest-cost fuel available.
- Up-to-date coal burning equipment can give you 10% to 40% more steam per dollar.
- Automatic coal and ash handling systems can cut your labor cost to a minimum.
- Coal is the safest fuel to store and use. No dust or smoke problems when coal is burned with modern equipment.
- Between America's vast coal reserves and mechanized coal production methods, you can count on coal being plentiful and its price remaining stable.

For further information or additional case histories showing how other plants have saved money burning coal, write to the address below.

NATIONAL COAL ASSOCIATION
Southern Building, Washington 5, D. C.

Circle 118 on READ-N-CIRCLE card

free bulletins

. . . just circle key numbers on READ-N-CIRCLE card on page 83

Air cleaning equipment

500-Dust collection manual

"The Collection and Recovery of Industrial Dusts," 32-page manual 101, discusses various types of dust and techniques used in analysis, lists the factors which influence choice of equipment, and explains operation. BUELL ENGINEERING CO., INC.

501-Improved electrostatic dust control

"Dust and Fume Control," 11-page bulletin G406, tells of the improvements and refinements that have been made in electrostatic precipitation since the first Cottrell precipitator was erected. Also included are background material and illustrations of the Multiclone mechanical dust collector, the CMP unit—a combination Multiclone and Cottrell unit, Dualaire dust collector, and Holo-Flite processor. WESTERN PRECIPITATION CORP.

502-Series on dust collectors, arresters

Series of four folders describes cyclone type collectors and portable, standard, and automatic bag-type dust arresters. Also includes 32-page catalog describing exhaust fans for dust collecting and air handling. NORTHERN BLOWER CO.

503-Using dust collectors

Dust collectors, including cyclone, wet or dry dynamic, and cloth screen arrester types are the subject of a 32-page bulletin. Uses of air conditioning, ventilating, conveying, drying, and cooling units are presented. KIRK & BLUM MFG. CO.

Air handling equipment

504-Industrial fan selection guide

Engineers and designers interested in quick, accurate selection of industrial fans for required capacities will find 27-page Bulletin EX-531 a useful, timesaving tool. The catalog introduces the type EX industrial fan, for medium speed, air and materials handling. BAYLEY BLOWER CO.

505-Explains curtain dampers

Booklet 1-HEA on curtain type dampers for flue gas control explains what the damper is and does, construction, dimensions, installations, and gives case histories. HEACON, INC.

Boilers and boiler accessories

506-Complete soot blower data

Bulletin 1137 gives complete information on the Model G9B blower which employs a fixed position rotating element to clean a large number of tubes by sweeping through a pre-determined arc. The bulletin suggests various uses. DIAMOND POWER SPECIALTY CORP.

507-Answers to hot water problems

Answers to your hot water problems are given in booklet "Methods and Means." Operation and advantages of the instantaneous water heater as compared to the indirect method heater are discussed and illustrated. PICK MANUFACTURING CO.

508-Boiler setting and baffle data

More than 30 boiler-setting plans are shown, with an analysis of how each arrangement of tubes is baffled to meet the specific boiler design, in 20-page Bulletin BW-54. THE ENGINEER CO.

509-Blowdown control chart

Determination of the rate of boiler blowdown and selection of a correctly sized heat exchanger are made possible with use of simplified Chart JPC, based on total dissolved solids in boiler water. Also given are recommendations for selection of blowdown equipment in accordance with normal operating conditions of the boiler installation. HENSZEY CO.

510-Water-tube generator specs

Completely packaged Water Tube Type D Superior Steam Generators in 17 sizes, with capacities from 8000 to 40,000 pound of steam per hour, are described in detail in eight-page Catalog 5M-54. SUPERIOR COMBUSTION INDUSTRIES, INC.

511-How to survey your steam needs

Formulas behind all package steam generators and illustrations of how a package steam generator installation can raise steam capacity without extensive structural changes are presented in Booklet "Sales Steam-2-1." An example shows how to make a professional survey of your own steam requirements. Complete records and two installation case histories are included. Twelve pages. CYCLOTHERM DIVISION, NATIONAL-U.S. RADIATOR CORPORATION.

512-Blowoff heat is free heat

Recover practically all of the heat of the blowoff water in a continuous blowoff system. Bulletin 5700 uses diagrams and text to explain how this steam may be used to heat feedwater in an open or deaerating heater and how it may be condensed in a closed heater or flash condenser to heat feedwater at a point beyond the deaerating heater. COCHRANE CORP.

513-Do your own boiler survey

Here's how to get a boiler survey form without obligation. Write for this bulletin covering the new CB self-contained boiler. Illustrations of installations, cutaway views of the boiler, and articles on how the units have proved themselves in specific applications are included. Four pages. CLEAVER-BROOKS CO.

514-Boiler cleaning

Four fact-filled pamphlets explain how this company's products will help you solve algae problems, increase boiler efficiency with use of the Ever Clean boiler process, remove rust, and prevent corrosion. NORTH AMERICAN MOGUL PRODUCTS.

515-Need steam in a hurry?

The advantages of completely assembled fast steaming boilers are discussed in Bulletin 1220. Available in sizes to 500 hp and pressures to 250 psi. Includes engineering data. Four pages. ORR & SEMBOWER, INC.

516-Handbook on startup

Handbook covers washing out new boiler, putting it in operation, handling in service, firing methods, and shut down. Includes big section of everyday engineering data. 48 pages. TITUSVILLE IRON WORKS CO.

Building construction, maintenance

517-Mortar joints repaired simply

These seven simple steps for repairing worn or corroded mortar joints of brick or tile floors are presented in Bulletin E-37. Procedure involves use of nonshrink, Embeco pre-mixed mortar. THE MASTER BUILDERS CO.

Corrosion control

518-Newest paints described

"Subox and Subalox Anti-Corrosive Paint—30th Anniversary," replaces the 25th anniversary issue you have in your files. It covers these paints as previously made and includes the newer varieties. Case histories show successful use of

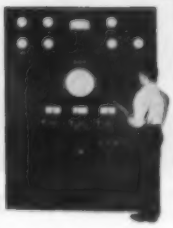
(more free bulletins on page 90)

Southern Building, Washington 5, D. C.

Circle 118 on READ-N-CIRCLE card

for the man considering a PACKAGE BOILER

new all-electric METERING TYPE PACKAGED CONTROL by HAYS



Now available for *all* makes and sizes of water tube type package boilers is the new all-electric, metering type Hays packaged control.

Metering type control provides maximum combustion efficiency regardless of the fuel burned because it *actually meters* the fuel flow and air flow, and automatically maintains the desired ratio. No adjustments are needed when changing fuels or oil burner tips.

All-electric operation includes not only safety devices but also steam, fuel, and air controllers and valves—uses only the normal source of AC voltage. No compressed air is required.

Fully automatic, safe and reliable operation is assured because Hays maintains the same industrial quality built into the largest utility combustion control system and it is factory tested before shipment.

Complete package in one simple and inexpensive to install panel board.

Write today for fact-filled Bulletin 53-1088-239.

THE hays CORPORATION

MICHIGAN CITY 2, INDIANA

Automatic Combustion Control • Veriflow Meters and Veritrol • Electronic Oxygen Recorders • CO_2 Recorders Boiler Panels • Gas Analyzers • Combustion Test Sets Draft Gages • Electronic Flowmeters • Miniature Remote Indicators • Electronic Feed Water Controls

Circle 119 on READ-N-CIRCLE card for more data

. . . for LOW COST STEAM TOMORROW

buy a SUPERIOR STEAM GENERATOR TODAY

Superior Steam Generators encompass the most complete line of packaged boilers available. Write for complete details today.
Fire Tube types to 600 b.h.p. (Write for Catalog 702 F).
Water Tube types to 45,000 lbs./hr. (Write for Catalog 702 W).

Man will reach the moon . . . tomorrow perhaps . . . but more than likely "tomorrow" in the dictionary of scientists means 20 years . . . and that's a long time to pay the penalty of high steam costs. A boiler is a long term investment; and the equipment you buy today determines your steam costs for years to come.

Superior Steam Generators are designed and built to last longer, and to operate at higher efficiencies throughout their entire serviceable life. Evidence of this you can see for yourself in Superior's bigger, heavier construction and completely integrated design. Superior Steam Generators provide more steam per dollar over a longer serviceable life.

for performance you can **BANK** *on*

SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

SUPERIOR
STEAM GENERATORS

Circle 106 on READ-N-CIRCLE card for more data

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handy guide

. . . to advertised products

Air cleaning equipment

PHAT-DANIEL CORPORATION. Control your industrial dusts and fly ash with engineered P-D Collector Systems. Reprint No. 102 will assist you in determining your requirements for dust and fly ash collectors.
Read page 15 and circle number 100.

NORTHERN BLOWER COMPANY. Norblo engineered dust collection systems are outstanding in all industries for high recovery, and low operating costs. Consult Norblo.
Read page 95 and circle number 151.

Air conditioning, heating

EDWIN L. WIEGAND CO. Quick, economical, electric heat for any application. Use coupon for additional data.
Read page 24 and circle number 101.

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Company address _____

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Air handling equipment

COPPUS ENGINEERING CORP. Ventilating problems solved by Coppus blowers. Check and mail coupon for data on your air problems.
Read page 17 and circle number 102.

Boilers and boiler accessories

DIAMOND POWER SPECIALTY CORP. Diamond "multi-port" bi-color gauge is earning wide acceptance everywhere. It offers excellent readability and substantial savings in gauge maintenance costs. Bulletin 1174.
Read page 36 and circle number 103.

ERIE CITY IRON WORKS. Sound engineering and design make Erie City steam generators the choice for new process steam applications in the petrochemical field.
Read page 29 and circle number 104.

THE LIQUIDOMETER CORP. Liquids worth storing are worth measuring with a Liquidometer tank gauge.
Read page 89 and circle number 105.

SUPERIOR COMBUSTION INDUSTRIES, INC. Superior's bigger, heavier construction assures longer life and higher efficiency. Catalog 702 describes complete line of boilers available.
Read page 82 and circle number 106.

YARNALL-WARING CO. More than 15,000 boiler plants use Yarway blow-off valves. Send for Bulletin B-426 which explains why.
Read page 42 and circle number 107.

PICK MANUFACTURING CO. Pick instantaneous hot water heaters are engineered for service. Write for the booklet on how Pick heaters cut cost of hot water.
Read page 38 and circle number 157.

Building construction, maintenance

FLEXROCK COMPANY. Repair broken factory floors without tie-up. This tough concrete patch sets instantly! Mail coupon for free booklet.
Read page 100 and circle number 108.

INDUSTRIAL GLASS FROSTING CO. Frosting your windows and skylights will give you better lighting and working conditions. Save money with Crystal Frost. Mail coupon for details.
Read page 16 and circle number 155.

THE KIRK AND BLUM MANUFACTURING CO. Fabrications for powerplant use. Any size, any shape can be pre-assembled by Kirk and Blum. Send for descriptive literature.
Read page 9 and circle number 109.

Communications systems

AUTOMATIC ELECTRIC SALES CORPORATION. Save manhours—get instant communication—install your own privately-owned PAX Business Telephone System. Write for an actual "on-the-job" case study.
Read page 3 and circle number 110.

Coming events

CHICAGO EXPOSITION OF POWER AND MECHANICAL ENGINEERING. Put this on your must list: The Power Show, November 14-18 in Chicago.
Read page 90 and circle number 111.

Electrical distribution

THE SUPERIOR ELECTRIC CO. End fluctuating voltage troubles with Stabiline automatic voltage regulators. Send coupon for full details.
Read page 41 and circle number 112.

I-T-E CIRCUIT BREAKER COMPANY, SMALL AIR CIRCUIT BREAKER DIVISION. New line of enclosed circuit breakers approved for service equipment and commercial buildings. Send for Speedfax catalog.
Read page 19 and circle number 113.

I-T-E CIRCUIT BREAKER COMPANY, SWITCHGEAR DIVISION. New developments in I-T-E low-voltage switchgear permit the use of lower-interrupting-rating breakers for short-circuit protection. You save. Send for information on new proposed industry standards.
Read page 20 & 21 and circle number 114.

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BUSSMANN MFG. COMPANY, DIVISION OF MCGRAW ELECTRIC CO. Save money on equipment with Fusetron fuses. Bulletin HCS describes Fusetron 10-point protection.
Read page 30 & 31 and circle number 115.

Fuels and firing equipment

THE CHESAPEAKE AND OHIO RAILWAY. There's a lot more to buying coal than considering the cost per ton. Want to solve your particular fuel requirements? Chesapeake and Ohio will be glad to help.
Read page 99 and circle number 116.

DETROIT STOKER COMPANY. There is a size and type of Detroit Stoker for every industrial need. Send for bulletin describing their utility and adaptability.
Read page 101 and circle number 117.

NATIONAL COAL ASSOCIATION. How to save money by burning coal is described by the Coal Association. Further information and case histories are available.
Read page 79 and circle number 118.

Instruments and controls

ERNST WATER COLUMN & GAGE CO. For high-pressure gage glasses, order from Ernst. Made in a variety of lengths and diameters. Send for catalog.
Read page 94 and circle number 158.

THE CAMBRIDGE INSTRUMENT CO., INC. Detect oxygen in feedwater, measure hydrogen and steam with gas analyzers. Bulletin 148B.P.
Read page 37 and circle number 152.

THE HAYS CORP. Now—packaged control for packaged boilers with the famous Hays quality. Bulletin 53-1088-230 gives facts on economy and ease of automatic operation.
Read page 81 and circle number 119.

HENSLEY CO. Flow meter sounds alarm, or activates a valve as well as measures flow. Details available in bulletin.
Read page 96 and circle number 120.

THE LIQUIDOMETER CORP. For gauging liquids of all kinds. One hundred percent automatic. Underwriters Laboratories approved. Write for complete details.
Read page 89 and circle number 105.

Lubrication

ADAM COOK'S SONS, INC. Albany brand features a full line of lubricating products.
Read page 22 and circle number 122.

THE HILLIARD CORP. Hilco maintenance equipment means complete oil purification. Send for new catalog and describe your purification needs.
Read page 23 and circle number 123.

NEW YORK & NEW JERSEY LUBRICANT COMPANY. Prolong the life of your equipment with Non-Fluid Oil. Send for free sample and Bulletin 506.
Read page 96 and circle number 153.

SINCLAIR REFINING COMPANY. Keep your Diesel engine cleaner with Sinclair Gascon lubrication. Write for details of better diesel performance.
Read page 11 and circle number 124.

THE TEXAS COMPANY. More stationary diesel hp in U. S. is lubricated with Texaco than with any other brand. Full story on request.
Read page 102 and circle number 125.

Maintenance

THE ARETOOL MFG. CO. Save on fuel with tube cleaners. Send for on-the-job demonstration.
Read page 91 and circle number 126.

ERIE BOLT & NUT CO. When it's time for a specialist in bolts and studs, send for Erie. Forty years' experience in high-quality, precision work.
Read page 85 and circle number 127.

L. B. FOSTER CO. Use Foster relayers to install and maintain rails. Send for catalogs to help you save on rails.
Read page 94 and circle number 128.

JOHNS-MANVILLE CORP. Spinotallic gaskets for all service conditions now color-coded for easy and permanent identification. Send for catalog PK-35A and color-code chart.
Read page 35 and circle number 129.

THE MASTER BUILDERS COMPANY. Do you have grouting problems? Embeco premixed grout will give you lasting results. Write for eight-page illustrated booklet.
Read page 94 and circle number 130.

PROTO TOOLS. Give your work the professional touch. PROTO provides the right power or impact socket you need. Send for catalog of the entire line of PROTO tools.
Read page 6 and circle number 131.

SMOOTH-ON MANUFACTURING COMPANY. Quick, low-cost emergency repairs possible with Smooth-On. Applies easily, hardens quickly, makes a tight durable seal. Free repair handbook.
Read page 32 and circle number 132.

SUBOX, INC. "Simplified Fence Painting" describes Subox fence paint system—can be applied with a broom.
Read page 88 and circle number 133.

THOMAS C. WILSON, INC. Tube cleaners and expanders that do a quick, economical job for you. Bulletin 500 gives money-saving data.
Read page 39 and circle number 134.

Power transmission

LOVEJOY FLEXIBLE COUPLING CO. Power transmission that is economical, easily installed, and maintenance free. Catalogs available.
Read page 34 and circle number 135.

RAYBESTOS-MANHATTAN, INC., MANHATTAN RUBBER DIVISION. Equalized-stress fea-

WHEN IT'S *Special* BOLTS *and* STUDS

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40 years' experience in making special bolts, studs, nuts for specific job requirements.

REPRESENTATION IN PRINCIPAL CITIES

Circle 127 on READ-N-CIRCLE card

handy guide

. . . continued from preceding page

ture gives this famous brand of rubber belting more power and longer life. Ask about Condor Compensated belts.
Read page 73 and circle number 136.

Pumping equipment

THE WEINMAN PUMP MFG. CO. Centrifugal pumps built by experts. Call the Weinman specialists to solve your pump problems.
Read page 27 and circle number 154.

Refractories and insulation

BIGELOW-LIPTAK CORP. B-L furnace enclosures with "stand-up stamina" offer long life and easy maintenance. Complete information available.
Read page 87 and circle number 137.

THE BABCOCK & WILCOX COMPANY, REFRACTORIES DIVISION. B&W refractories win out where it counts, on performance. B&W will help you cut installation costs and lengthen furnace life.
Read page 33 and circle number 138.

Traps, strainers, and separators

ARMSTRONG MACHINE WORKS. Prevent corrosion of unit heaters by trapping. Handbook 2312 gives data on selecting and installing traps for any type unit heater.
Read page 2 and circle number 139.

THE JOHNSON CORP. Eliminate condensate flashing and cooling loss, with the Johnson Electrap. New data book gives complete engineering information.
Read page 89 and circle number 140.

RONNINGEN MFG. CO. Remove iron with Ronningen filters—can be cleaned in 60 seconds. Details in bulletin 25406P.
Read page 14 and circle number 141.

STRONG, CARLISLE AND HAMMOND COMPANY. Reduce steam costs, increase protection with Strong Hydro-Flex traps. Bulletin SS-40.
Read page 97 and circle number 142.

Turbines

ALLIS-CHALMERS. Low-cost installation and operation are features of modern, compact, WA-Series steam turbine-generator units, available now in new, higher ratings. Bulletin 03B7654 gives complete data.
Read page 75-78 and circle number 143.

Valves and regulators

THE CHAPMAN VALVE MANUFACTURING COMPANY. Trouble-free control of valves and sluice gates assured with Chapman Motor Units. New catalog 51 available.
Read page 7 and circle number 144.

LESLIE CO. Stop erosion with exclusive Stellite seating surface, standard equipment with Leslie. Ask for demonstration. Handbook 5552 on use of controllers and regulators available.
Read page 25 and circle number 145.

THE POWERS REGULATOR COMPANY. Wasting fuel by overheating water? Powers regulators pay for themselves in fuel savings. Bulletin 329.
Read page 28 and circle number 156.

REPUBLIC MFG. COMPANY. For a complete line of valves, see your Republic distributor in principal cities.
Read page 100 and circle number 146.

Water supply and treatment

W. H. & L. D. BETZ. Increase efficiency, practice economy. Take advantage of Betz continued research in water treatment.
Read page 13 and circle number 147.

THE BIRD-ARCHER COMPANY. Complete engineering services for water treatment. Write for literature.
Read page 93 and circle number 148.

HUNGERFORD & TERRY, INC. A complete line of water conditioning systems is available from H&T. All sizes, all capacities, manual or automatic. Send for bulletin.
Read page 14 and circle number 149.

THE NORTH AMERICAN MOGUL PRODUCTS COMPANY. New—Mogul "Kwik-Kleen" scale remover, safe and effective. Let Mogul solve your scale problems.
Read page 8 and circle number 150.

coming next month in INDUSTRY & POWER....

Civil Defense Profile of Industry

You will have the opportunity to participate in the first project of its kind — taking the profile of Industry's Power Services civil defense readiness. Next month, INDUSTRY & POWER will carry a Profile Questionnaire for you to fill out about the standby capacities of the Power Services in your plant. The Profile is designed for rapid reading, and will take but a few minutes of your time. When we have completely tabulated the data you send in, we will be able to crystallize further our forthcoming editorial program for civil defense in Industry's Power Services. Through the pages of INDUSTRY & POWER for October, you will be able to help us help you.

Watch for the October issue....

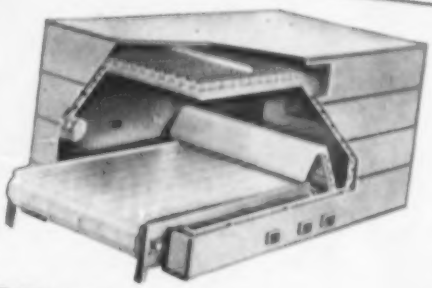
INDUSTRY & POWER

MOIST FUEL CELLS

An important application of B-L unit-suspended walls and arches is found in furnaces where a fuel with a high moisture content is burned. Although designed primarily for use in cane sugar countries for bagasse burning, these furnaces have proven so successful in other fields such as the burning of bark and wet wood refuse.

BIGELOW-LIPTAK *Corporation*

UNIT-SUSPENDED WALLS AND ARCHES



DRYER FURNACES

A tough assignment for a furnace is to stand up under the every-day beating of heat in drying applications. B-L's streamlined thin wall dryer furnace does it—cuts maintenance to boot. It furnishes heat for drying coal, sugar, salt, lumber, chemicals.

BIGELOW-LIPTAK *Corporation*

LOWEST MAINTENANCE

Castable Linings

B-L's castable lining for oil refining furnaces provides a smooth monolithic wall capable of resisting abrasion and standing up under high heat demands. The construction is adaptable to catalytic regenerators, catalytic reactors, cyclones, stacks and other refinery equipment.

BIGELOW-LIPTAK *Corporation*

UNIT-SUSPENDED WALLS AND ARCHES

When you specify a B-L furnace enclosure you can be sure of long life and lowest possible maintenance. Intelligent engineering and top-quality materials provide the stand-up stamina that makes enclosures "tougher than blazes." Each unit is individually designed for the job. Write today for complete information.

BIGELOW-LIPTAK *Corporation*

AND BIGELOW-LIPTAK EXPORT CORPORATION

2550 WEST GRAND BOULEVARD, DETROIT 8, MICHIGAN

UNIT-SUSPENDED WALLS AND ARCHES

In Canada: BIGELOW-LIPTAK OF CANADA, LTD., *Toronto, Ontario*

ATLANTA • BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND • DENVER • HOUSTON • KANSAS CITY, MO. • LOS ANGELES • MINNEAPOLIS • NEW YORK
PITTSBURGH • PORTLAND, ORE. • ST. LOUIS • ST. PAUL • SALT LAKE CITY • SAN FRANCISCO • SAULT STE. MARIE, MICH. • SEATTLE • TULSA • VANCOUVER, B.C.

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Easily...Economically with Subalox

Subalox is a complete paint system, so easy and economical to use that a single coat gives an excellent and lasting job. Can be applied by customary methods, but for most satisfactory application we recommend floor brooms.

Subalox is based on a heavy collodial lead pigment which gives excellent rust protection and limits spattering when applied to wire mesh.

Subalox is available in a variety of colors—the most popular being the metallics used to simulate the appearance of galvanizing. Old fences can be given a "new look" which can be easily maintained with a minimum of time, labor and material cost.

Detailed instructions are contained in "SIMPLIFIED FENCE PAINTING"—yours for the asking.

Subox Inc.

9 Fairmount Plant, Hackensack, N. J.

Circle 133 on READ-N-CIRCLE card

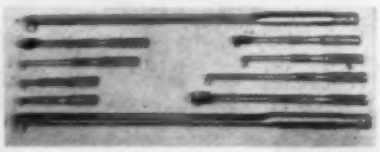
new equipment

. . . starts on page 10

2 percent, it requires no accessories. Is completely self-contained. Can be wound, focused, synchronized to stop motion, and then can be read at leisure. BOULIN INSTRUMENT CORPORATION.

715-Torque wrenches with super-precision calibration

Torque-limiting wrenches are calibrated to an accuracy of three percent, plus a maximum of two pounds. When the desired torque (preset on the micrometer-type handle) is reached, wrench releases automatically, signals, and resets itself. New line includes ten models with ¼-, ⅜-, ½-, and ¾-inch drives, plain and ratchet heads, and with capacities from 5 to 4800 inch-pounds and 100 to 500 foot-pounds. PROTO TOOL COMPANY.



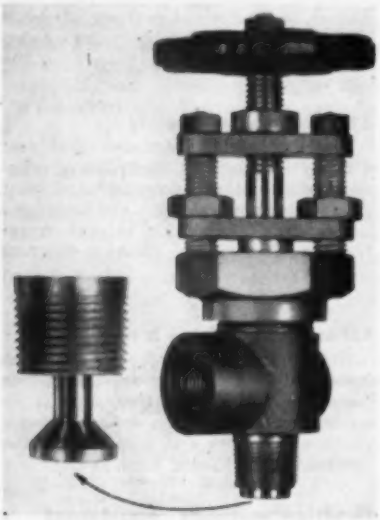
716-Hand-operated shear handles machine-sized jobs

Hand-operated shear cuts up to 2-inch by ¼-inch flat or ⅜-inch round steel bar, or No. 10 SWG sheet steel. Develops a high cutting force by means of a power gearing system. Cutting point is always visible. Eliminates many hacksaw jobs. Cuts mi-

tres, bevels, flats, and curves. Long-life blades can be quickly replaced if damaged. JOHN OULD, LTD.

717-Self-draining sampling valve has seat outside body

Sampling valve that prevents liquid from remaining in nipple and valve is ideal for installation where valve seat must be inside vessel wall. Valve has an outside screw and yoke construction. Is recommended for pressures up to 4000 pounds at 100 °F, or 1000 pounds at 750 °F. Standard construction is carbon steel body, stainless steel stem, and Stellited seat. Special alloys are optional for extremely corrosive conditions. Optional accessories include an additional outlet for steaming-out connection, or a reamer on the stem end for breaking away encrusted matter that has collected on the inside vessel wall. JERGUSON GAGE & VALVE COMPANY.



FREE INFORMATION

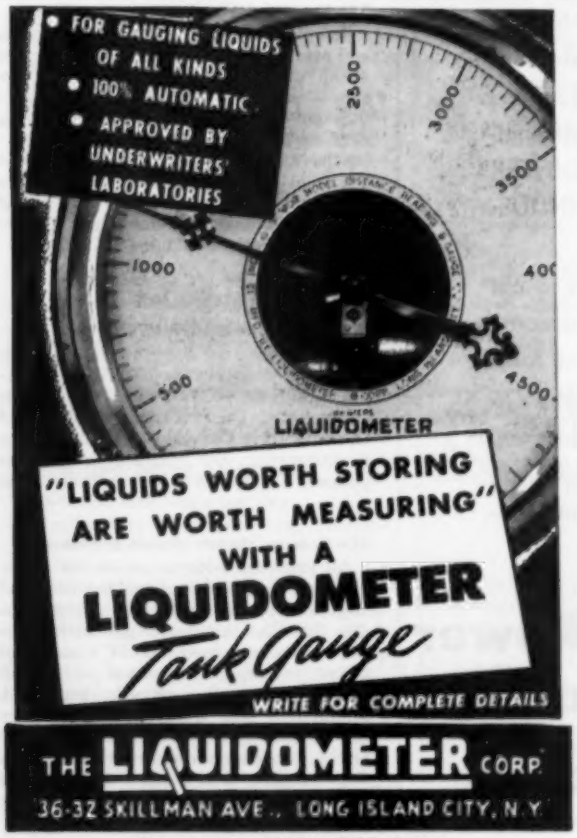
For detailed free information on these products just circle the key numbers on the READ-N-CIRCLE card on page 83.

718-Low-cost variable speed pulley needs no lubrication

Low-cost ¾-hp variable speed pulley that can be readily adapted to new or old equipment uses oil-impregnated bronze bearings for life-long lubrication. The pulley delivers a speed ratio of 2¾:1, using an A-section belt. Maximum bore is ⅞ inch with keyway. Bore runs the entire length of the pulley for reverse mounting, if required. Unit has 4-13/16-inch overall length, 6-inch diameter. Weighs 6½ pounds. LOVEJOY FLEXIBLE COUPLING CO.

719-Ventilating skylights get remote control

Self-contained curb and roof flange eliminate need of additional flashings for installation of this ventilating skylight. Unit has extruded aluminum frames and Fiberglas panels. Scuttle can be either manually operated or motorized for remote control. THE MARCO COMPANY.



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END FLASH LOSS and COOLING LOSSES...
. . . in handling condensate from high pressure processing equipment
Here's the system, engineered around the Johnson Electrap, that gets high temperature condensate back to boiler room with all heat units still intact. In contrast with the usual pump and receiver installation, it eliminates the losses that come with unrestricted flashing of condensate and the addition of cooling water. In many cases this can mean direct savings of 10% and more in fuel and power.
New Data Book has complete engineering information; write for copy today.
The Johnson ELECTRAP for Pumping Service
The Johnson Corporation
807 Wood St., Three Rivers, Mich.

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CHICAGO EXPOSITION OF POWER & MECHANICAL ENGINEERING

A TWO-FOR-ONE EVENT!

The Exposition is under the auspices of the ASME—and is in conjunction with the Society's final 75TH ANNIVERSARY MEETING. This great Diamond Jubilee Meeting, marking three-quarters of a century of engineering progress, has as its theme "THE ENGINEER AND THE WORLD OF COMMERCE AND INDUSTRY."

AT THE EXPOSITION YOU'LL SEE new ways to put power to work for greater productiveness and economy—a world of new, helpful information under one roof!

Be sure to see the CHICAGO EXPOSITION OF POWER & MECHANICAL ENGINEERING when you attend the 75TH ANNIVERSARY MEETING of ASME. Put it on your calendar now! Write the Exposition Management today for advance registration.

Chicago Exposition of Power & Mechanical Engineering

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480 Lexington Avenue, New York 17, N. Y.

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free bulletins

. . . starts on page 80

Subox paints on various types of industrial equipment. SUBOX, INC.

519-Handy protective coating chart

Tables of properties, application techniques, and industrial uses are offered in Catalog 2-55-3M. Twelve pages. AMERCOAT CORPORATION.

520-How to paint properly

This profusely illustrated Bulletin GET-677F includes a discussion of proper painting methods, preparation of paint, number of coats required, and includes a discussion of repainting subway transformers. Eight pages. GENERAL ELECTRIC COMPANY.

521-Metallurgy library is free

Helpful publications for all engineers interested in metallurgy are included in Lists A and B. All are free, and list includes an invitation to submit specific problems. Twenty and eight pages. THE INTERNATIONAL NICKEL COMPANY.

Drafting methods, equipment

522-Simplify your drafting practices

Sample drawings of engineered parts and assemblies illustrate the eleven rules (from the use of word descriptions for simple parts to making freehand drawings wherever possible) for simplifying drafting practices. These simplified methods have shown that it is possible to cut the total number of hours required to complete a given volume of work by 40 to 50 percent. Thirty-six pages. AMERICAN MACHINE AND FOUNDRY COMPANY.

Electrical distribution

523-Current-limiting fuse charts

Hi-Cap fuses for the protection of loads above 600 amperes are described in six-page Bulletin HCS. Two handy charts are included: Current Limiting Effect and Opening Time Curves. Use of these fuses in conjunction with Fusetron fuses is explained. BUSSMANN MANUFACTURING CO.

524-How to choose circuit breakers

All essential information on the selection and application of molded case and large air circuit breakers is presented in this Speedfax catalog. Application sections make extensive use of charts and tables to explain selection of circuit breakers for motor circuits, bus duct, conductors, and transformer secondary applications. Also included are the latest prices, dimensions, and ordering instructions—arranged and indexed to reduce reference time and errors. Sixty pages. I-T-E CIRCUIT BREAKER COMPANY.

525-How to select connectors

"How to Select and Use Today's Electrical Connectors," nine-page Technical News Letter 24, contains two articles on design of electrical connectors and their efficient application in modernizing industrial plants' electrical distribution systems. BURNDY ENGINEERING CO., INC.

Electrical utilization

526-Heat with electricity

Industrial electric heating applications and methods are described in 32-page Booklet, "101 Ways to Apply Electric Heat." Illustrated case histories show experience-tested ways to apply metal-sheathed Chromalox electric heating units in industrial jobs. EDWIN L. WIEGAND CO.

527-Surface heating guide

"Handy Selector Guide for Surface Heating," four-page Folder GEA-6146, shows which type of heater to use for specific jobs, how to determine heater rating, how to calculate heat-up time, and how to select thermostats. GENERAL ELECTRIC COMPANY.

FREE COPIES

For free copies of these handbooks, bulletins, and catalogs just circle the key numbers on the READ-N-CIRCLE card on page 83.

528-Automation through speed control

Colored cross-sections and diaphanous views show how pneumatic control has been designed into U. S. Varidrive motors to increase and improve production output. Bulletin 1882 shows typical automatic control applications. Eight pages. U. S. ELECTRICAL MOTORS, INC.

529-Handy pocket charts

Charts for wire gauge and temperature conversion are available in a pocket-size Bulletin No. GEZ-1510. The bulletin is printed on durable plastic material in large easy-to-read type. GENERAL ELECTRIC COMPANY.

Fuels and firing equipment

530-Refuse and wood burning

Engineering data concerning spreader stokers installed to burn refuse or wood are contained in 24-page Booklet 505. Stationary, manual dumping, power dumping, and traveling grate installations having maximum capacities from 10,000 to 275,000 pound steam per hour are described. DETROIT STOKER CO.

531-Underfeed stokers explained

The latest refinements in single retort underfeed stokers are discussed in 12-page Catalog SB53. Both the fluid ram and gear drive units are described in de-

Scale Down fuel costs with AIRETOOL tube cleaners

Outside of a physical demonstration, this is the most graphic way we know of illustrating to you how Airetool tube cleaning equipment can cut your fuel costs down to a bare minimum.

We'd be glad to provide an *on-your-job demonstration* of the dependability and efficiency of Airetool equipment . . . how in minutes instead of hours the worst profit-robbing, scale-clogged tube, straight or curved, can be skillfully cleaned, slick as a whistle.

Call today, won't you, or if you prefer, write or wire for prompt attention to your tube maintenance needs.

AIRETOOL
MANUFACTURING COMPANY
SPRINGFIELD, OHIO

Branch Offices: New York, Chicago, Philadelphia, Tulsa, Houston, Baton Rouge
Representatives in principal cities of U.S.A., Canada, Mexico, South America, England and Japan.
European Plant: Airetool Nederland N.V., Vlaardingen, The Netherlands.

There's an Airetool Tube Cleaner and Expander for EVERY Type of Tubular Construction.

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coming next month in....

INDUSTRY & POWER

special problems with outdoor packaged steam generators

Minor problems can be as troublesome as major ones until they are finally licked. D. W. Karger, chief plant engineer at Magnavox Company, writes about the problems he ran into last winter with his packaged steam generator. His plant is in Fort Wayne, Indiana, a location that serves up some fairly severe winter weather. But all problems are solved neatly. Read how in the

October Issue of

INDUSTRY & POWER

free bulletins

. . . starts on page 80

tail by means of text, elevation and cutaway drawings. ERIE CITY IRON WORKS.

Instruments and controls

532-Control devices guide

Photos, diagrams, and specifications for key switches, impulsing devices, switchboard lamps, and other control devices are given in 28-page Bulletin 4018-D. AUTOMATIC ELECTRIC CO.

533-New combustion sampling

The full story of a newly developed sampling system for continuous trouble-free sampling and oxygen measurement of combustion processes is told in Bulletin 703. The equipment described is designed for steam generating plants, rotary kilns and driers, open hearth furnaces, and tanks. ARNOLD O. BECKMAN CO., INC.

534-Measure your feedwater gas

Described in four-page Folder 148BP is an analyzer for measuring dissolved oxygen and hydrogen in feedwater. Advantages, ranges and accuracy are discussed. CAMBRIDGE INSTRUMENT CO., INC.

535-Mercury-less flow meters

Choice of several mercury-less transmitters is offered with these electronic flow meters, described in Bulletin 55-1074-222. They are suitable for measurement of differential pressures, liquid level, fluid, gas, air or steam flow, temperatures, and pressures. Combination of flows or flow and level can be recorded on the same chart. THE HAYS CORPORATION.

536-Air switches divert pressure

A broad line of pneumatic switches is available for surface or flush mounting. A gradual switch that slowly increases delivery pressure is also described in Bulletin 357. Two pages. THE POWERS REGULATOR CO.

537-Combined temperature regulators

Temperature control by means of temperature regulators that combine both a pressure and thermal element is discussed in four-page folder 1008. Installation drawings point out how the Spence Type ET150 regulator can be used with an instantaneous water heater, a storage water heater, and a forced warm air heating system. SPENCE ENGINEERING CO., INC.

538-Make best use of controls

To realize greatest benefits from automatic control, your knowledge of products and processes must be supplemented by an intimate knowledge of control engineering. Bulletin S-10 describes how to arrive at the right application of an automatic control system. Several case histories are cited. Fourteen pages. AUTOMATIC TEMPERATURE CONTROL CO.

539-Automation dictionary

This "Automation Dictionary" covers some 87 words and phrases in the expanding vocabulary of automation. These are not standard engineering definitions but new engineering terms defined for the understanding of the average engineer. MINNEAPOLIS-HONEYWELL REGULATOR CO., INDUSTRIAL DIV.

FREE COPIES

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Lubrication

540-Oil seal manual

Quick reference manual covers selection, application, and installation of clipper oil seals. Descriptions cover the latest seal designs, including extruded and molded oil slingers and end face seals. Essential data is in tabular form. Important points are well illustrated. Twenty-eight pages. JOHNS-MANVILLE.

541-Do's and don'ts for bearings

A helpful list of "do's" and "don'ts" to prolong bearing life appears in Bulletin 506. Also included is information on the storage and handling of lubricants. Four pages. NEW YORK AND NEW JERSEY LUBRICANT CO.

542-Diesel lubrication revised

Written for everyone interested in the lubrication of diesels, "Lubrication of Diesel Engines," has been revised as Technical Bulletin B-1, 48 pages. It discusses diesel principles and design, types of engines in use, operating cycles, accessories and choice of lubricants. SUN OIL CO.

Maintenance items

543-Effective tube cleaning

Bulletin 44 introduces a new geared tube cleaner for removing scale in heat

exchanger and condenser tubes of ⅜ to 2½ inch ID. The unit is particularly effective where conditions require low speed and great power. AIRETOOL MFG. CO.

544-Rail spur maintenance handbook

Handbook D-3014 discusses maintenance of roadbeds, rails and joint bars. Covers importance of ties, tie plates, and spikes. Sixteen pages. L. B. FOSTER CO.

545-Portable oil maintenance units

New portable line of oil filters makes possible on-the-spot maintenance of lubricating and industrial oils. Bulletin 316 also includes information, illustrations, and references about combination oil filters and reclaimer units. These units are ideal for filtration and vacuum vaporization of water and other volatile contaminants in turbine, diesel, transformer, transmission and hydraulic oils. Four pages. THE HILLIARD CORPORATION.

Torque wrenches in wide range

Both inch-pound and foot-pound torquers are described in this complete 68-page catalog. Types included are for a wide range of drive sizes with plain or ratchet head. *Please send requests directly to PROTO Tool Co., Dept. IP, 22762 Santa Fe Ave., Los Angeles 54, Calif., with 10¢.*

546-Repair leaks with cement

Text and illustration in this 48-page handbook present repair methods for leaks in pipes, boilers, radiators, concrete, cinderblocks, and sheet and plate metal. Directory describes 12 repair cements and jobs they will do. SMOOTH-ON MFG. CO.

547-Modern tube expander news

The latest tube-expanding equipment available for fire-tube boilers, water-tube boilers, condensers, and similar heat transfer units is explained with the aid of drawings in news bulletin. Reference is made to bulletins with specifications and technical data. Typical boiler and condenser units are illustrated for which the expanders are recommended. Four pages. THE GUSTAV WIEDEKE COMPANY.

548-Quick reference for packing

Having trouble selecting the proper packing for a specific problem? This catalog outlines a complete line of rod and sheet packings, gasket cutters, and accessory items to meet almost every industrial requirement. Charts give quick reference material. Forty-eight pages. THE ALLPAX COMPANY, INC.

549-Condenser tube inserts

How to restore leaking condenser tubes to service by sealing off the deteriorated portion with inserts, is the subject of four-page leaflet 500. Tube cleaners, expanders, and maintenance tools are listed. THOMAS C. WILSON, INC.

PORTFOLIO OF BIRD-ARCHER ENGINEERING SERVICES FOR WATER TREATMENT

For experienced counsel and personal attention to water or steam problems at your plant, it will pay you to call on Bird-Archer's qualified engineers. Highest quality chemicals and over sixty years experience assure maximum results with Bird-Archer's Complete Water Treatment Service.

PLANT SURVEY
Studies of your use of water or steam equipment and past performance.

WATER AVAILABILITY STUDY
Analysis of water supplies starting at source.

LABORATORY SERVICE
Experienced chemists specialize in scientific water analyses and research.

DEVELOPMENT OF TREATMENT AND CONTROL SYSTEMS
Operational changes where necessary.

CHEMICAL TREATMENT FORMULATION
Bird-Archer custom formulates chemical treatments for your specific problems.

EQUIPMENT RECOMMENDATIONS
Specification and furnishing of additional equipment when necessary, including complete analysis of savings and benefits made possible.

PLANT STAFF INSTRUCTION
Experienced technicians instruct your personnel in accurate control and test procedures.

PERIODIC CHECK-UPS
Personal call-backs to your plant by a Bird-Archer Service Engineer to assure best possible results.

WRITE FOR LITERATURE

ENGINEERING PLUS CHEMISTRY EQUAL BIRD-ARCHER SERVICE
For Power For Process For Cooling

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WATER TREATMENT
THE BIRD-ARCHER COMPANY, 4337 N. AMERICAN ST., PHILADELPHIA 40, PA.
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BIRD-ARCHER COMPANY OF CALIFORNIA, San Francisco

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for hard—tough—dense concrete repairs..

Non-Shrink

EMBECO PRE-MIXED MORTAR

Outlasts and outwears plain cement-sand patches because...

send for folder

- *Does not shrink* upon hardening.
- Bonds tightly to old concrete and mortar.
- Tough iron particles serve as reinforcement.
- Density resists water and oil penetration.
- Higher compressive and impact-resistant strength.
- Hard—contains no asphalt.

EMBECO PRE-MIXED MORTAR IS READY TO USE—you add only water.

Used to patch cracks, disintegrated and worn concrete floors, walks, steps, walls, etc.

Write for 4 page folder illustrating many applications.

Creators and Manufacturers of Products to Improve Concrete and Mortar

THE MASTER BUILDERS CO.

CLEVELAND 3, OHIO — Subsidiary of American-Marietta Company — TORONTO 13, ONTARIO

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Here's how we

SAVE ON RAILS

BUY "GUARANTEED RELAYERS"

Handle more cars better — spend less to install and maintain with Relayers from Foster. "Open-stock" shipments from Foster warehouses, all sections 12# thru 175# — plus Switch Materials and Track Equipment items.

Send catalogs ☐ *Rails* ☐ *Track Equipment*
☐ *Send Free 'Track Maintenance' Book IP-9*

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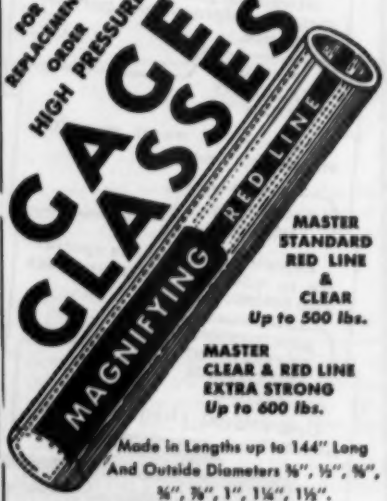
FOR HIGH PRESSURE REPLACEMENTS ORDER

GAGE GLASSES



MASTER STANDARD RED LINE & CLEAR *Up to 500 lbs.*

MASTER CLEAR & RED LINE EXTRA STRONG *Up to 600 lbs.*

Made in Lengths up to 144" Long
And Outside Diameters ⅜", ½", ⅝", ¾", ⅞", 1", 1¼", 1½".

High Pressure Composition

ERNST RUBBER GASKETS

All sizes to fit your gages and valves

FIG. 21—Lip Mold FIG. 22—Standard

ERNST WATER COLUMN & GAGE CO.

Send for Catalog LIVINGSTON, N. J.

Circle 158 on READ-N-CIRCLE card

free bulletins

. . . starts on page 80

Materials handling (bulk)

550-Storage for bulk materials

If you handle flowable bulk materials such as ashes, coal, coke, sand or lime, or use cooling towers, dust bins, mixing tanks, stacks or well houses, read Bulletin 20-10-50-N. Twelve pages. THE NEFF & FRY CO.

551-Conveyor belt design chart

Engineering data for standard conveyor belt construction is shown in color on this chart for eight of the most popular ply and material combinations. It shows theoretical ultimate strength, actual ultimate strength, faster strength, operating strength with fasteners and with splice, and troughing index. A separate data sheet is included. QUAKER RUBBER CORP., DIV. OF H. K. PORTER CO., INC.

Power transmission

552-Need a speed changer?

Operating advantages of "Vari-Pitch" speed changers are described in Bulletin 20B6013D. Available in twelve sizes from 1 to 75 hp with output speeds ranging up to 2900 rpm. Speed changers operate in either vertical or horizontal position. Suitable for reversing service with addition of a simple, low-cost tension stabilizer. Includes arrangement diagrams, selection and speed range tables. ALLIS-CHALMERS MANUFACTURING COMPANY.

553-Poly-V belt drive characteristics

Design characteristics of the Poly-V drive, a single, endless belt with molded lengthwise ribs, are explained in eight-page Folder 6638. Line drawings and text compare the Poly-V with conventional drives and point out advantages. MANHATTAN-RUBBER DIV., RAYBESTOS-MANHATTAN.

554-Revised JIC hydraulic standards

Your personal copy of the JIC Hydraulic Standards for Industrial Equipment, including complete, unabridged revisions made at the January '53 meeting of the JIC is available. It is punched for insertion in standard catalog binders. Twenty pages. MILLER FLUID POWER CO.

555-New gear manual is a must

Illustrations, diagrams, definitions, tables, charts, and explanations regarding all types of gears are offered in Manual G655. For the first time, a simplified method of calculating horsepower ratings of all types of gearing is presented. This free manual is a must for all plant engineers. Seventy-six pages. PHILADELPHIA GEAR WORKS.

556-V-Belt rating manual

Multi-V-Drives—This 100-page master engineering manual presents a scientific and simplified method for rating V-Belts. In addition to accepted theories on V-drive engineering, factors such as small diameter sheaves, centrifugal force, average hours per day operation, and other conditions affecting belt lines have been considered. WORTHINGTON CORP.

Pumping equipment

557-Centrifugal pump specs

Centrifugal Pumps—Four-page Bulletin 519-A gives complete information on the Type SB horizontally split case, double balanced suction pumps including dimensional drawings. WEINMAN PUMP MFG. CO.

FREE COPIES

For free copies of these handbooks, bulletins, and catalogs just circle the key numbers on the READ-N-CIRCLE card on page 83.

558-How to figure pump heads

How to determine total head against which pump must operate is only one of the valuable sections in 12-page Bulletin 353-1000 on the Bilton pump, a general purpose pump suitable for medium and low head service. BYRON JACKSON CO.

Refractories and insulation

559-How to select refractory

"Boiler Refractories," 20-page Bulletin R-36, has been designed to provide operators of stationary and marine boilers with an authoritative guide for selecting the most efficient and economical refractories for their boilers. BABCOCK & WILCOX CO., REFRACTORIES DIV.

560-Refractory construction

The different types of construction considered standard for industrial refractory are described in Bulletin 39. Profusely illustrated. Twenty pages. BIGELOW-LIPTAK CORP.

561-Refractory concrete manual

"Refractory Concrete Manual," 16-pages, covers basic information on recommended practice for mixing and placing refractory concrete. Lumnite Div., UNIVERSAL ATLAS CEMENT CO.

Refrigeration

562-Specifying refrigerant receivers

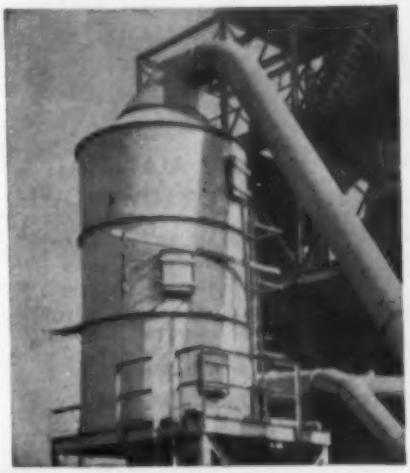
"Liquid Receivers for Ammonia and Freon," 4-page Bulletin LR-1, gives all the information necessary for specifying these units and includes elevation drawings to show typical installations. HENRY VOGT MACHINE CO.

For All Fume or Dust Collection—

Norblo

brings you outstanding efficiency in three types of systems

Centrifugal



Hydraulic

Automatic Bag Type

WHATEVER your need for dust or fume control, Norblo builds rugged, efficient equipment in Centrifugal, Hydraulic and Bag type collecting systems. These three types, frequently used in certain combinations, provide economical dependable control as required in smelting, rock products, chemical, milling and processing fields.

Norblo Systems make outstanding records for high recovery with low operating and maintenance costs. Profit by Norblo's 30 years experience in heavy duty collection and Norblo development of these basic types of equipment. For good advice on dust or fume problems, consult Norblo.

The Northern Blower Company

Engineered Dust Collection Systems for All Industries

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A FULL TIME TRAFFIC COP
on your fluid hiway

HENSZEY
FLOW METERS
with Alarm Control

RINGS A BELL—LIGHTS A LIGHT or ACTIVATES a MOTORIZED VALVE

There are only three moving parts in the HENSZEY FLOW METER — no breakdown due to complicated gears and mechanism. Goes right in the line — no additional supports. Indicates flow within 3% absolute accuracy, even with pulsating flow. Send for bulletin.

SOUND ALARM AT HIGH OR LOW FLOW!

Easy to set on face of switch — unaffected by dust, dirt or corrosion — no pitting or sticking.

HENSZEY COMPANY
DEPT. A-9, WATERTOWN, WISCONSIN
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NON-FLUID OIL
TRADE MARK REGISTERED

THE LONG LIFE LUBRICANT!

NON-FLUID OIL "stays alive" longer than ordinary greases to safeguard bearings against excessive wear.

Lubrication engineers agree that NON-FLUID OIL protects highly polished surfaces most effectively against pitting and corrosion,— resulting in longer bearing life.

Manufacturers of motors and machinery recommend NON-FLUID OIL because it *prolongs* the life of equipment.

Write today for free testing sample and Bulletin No. 506.

NEW YORK & NEW JERSEY LUBRICANT COMPANY
292 Madison Ave., New York 17, N. Y. • Works: Newark, N. J.
WAREHOUSES: Birmingham, Ala. • Atlanta, Ga. • Columbus, Ga. Charlotte, N. C. • Greensboro, N. C. • Greenville, S. C. • Chicago, Ill Springfield, Mass. • Detroit, Mich. • St. Louis, Mo. • Providence, R. I. Also represented in other principal cities.

NON-FLUID OIL is not the name of a general class of lubricants, but is a specific product of our manufacture.

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free bulletins

. . . starts on page 80

Traps, strainers, and separators

563-Traps fit all needs

Ball float traps for draining water from air, gas, or steam lines or for draining light liquids from gas under pressure are described in eight-page Bulletin 289. An orifice capacity chart and tables of maximum operating pressures help in selection. ARMSTRONG MACHINE WORKS.

564-Light-load steam trap

A ½-inch impulse steam trap especially designed with low capacity to handle light condensate loads is now available. The trap will not freeze or air bind on steam tracer line service. It is good for all pressures to 400 psi. Bulletin T-1740-20A gives a complete description. YARNALL-WARING COMPANY.

FREE COPIES

For free copies of these handbooks, bulletins, and catalogs just circle the key numbers on the READ-N-CIRCLE card on page 83.

Valves and regulators

567-Pressure valves for all ranges

Catalog 10 describes List 960 and 990 valves. The 960 is for a pressure range of 200 lb at 100 F to 380 lb at 1000 F. The 990 is for higher pressures. CHAPMAN VALVE MANUFACTURING CO.

568-Why not a solenoid valve?

If you use direct operated solenoid valves for automatic or remote flow control of liquids and steam up to 400 F, or of high viscosity liquids you will want to read 11-page Bulletin V-2. Normally closed, normally open, explosion-proof normally closed, and three way valves are shown. THE JOHNSON CORP.

569-Control valve reference book

Three basic types of single seated diaphragm control valves are discussed in 15-page Bulletin 5304. Cut-away views and charts with complete specification data make this a good reference book. LESLIE CO.

570-Data for full line of valves

Complete lines of valves for industrial use that meet a wide range of pressure, temperature and corrosion conditions are

offered in Catalog No. 654. Specifications and engineering data are included. Sixty-six pages. REPUBLIC MANUFACTURING CO.

571-Selection tips for regulating valves

Automatic regulating valves, float valves, back-pressure valves, reducing valves, and tank thermostats are described with selection tips and complete engineering data in tabular form in Catalog 54. Sixty-eight pages. KLIPPEL VALVES, INC.

Water supply and treatment

572-Meet the film-forming amines

"Film Forming Corrosion Inhibitors Also Aid Heat Transfer," four-page Technical Paper No. 129, contains references to protection afforded by filming amines and attendant reduction in maintenance costs secured through protection against corrosion. W. H. & L. D. BETZ.

573-How to use package feeders

Proportioning pumps and package chemical feeding units are described in this four-page folder. With liquid ends available for about 85 percent of all chemical pumping requirements, the pump is designed for use where a controlled capacity of fluid is necessary. How the feeding unit can be connected to the piping of your plant and to the electrical control equipment is explained. BIRD-ARCHER CO.

574-All phases of purification

"Boiler Feedwater Treatment," 19-page Bulletin BFT-1, covers Inversand zeolite softeners, color process chemical softeners, and demineralizing units, including silica removal by ion-exchange. HUNGERFORD & TERRY, INC.

575-Demineralizing handbook

"Handbook on Demineralizing," 40-page Bulletin 5800-B, compares various methods of water treatment including demineralizers and evaporators. It goes into characteristics of various types of cation and anion exchange materials and operating costs. COCHRANE CORP.

576-Recirculation treatment chart

A method for protection of cooling water equipment and recirculating water systems is presented in Bulletin 68. Includes handy check chart to help indicate if your system would benefit from this treatment, and explains how it works. Four pages. NATIONAL ALUMINATE CORP.

577-How to supply your own water

Methods of abstracting water from the ground or by infiltration through permeable beds of rivers or other bodies of water are discussed in 20-page bulletin. Performance charts for this company's collector are supplemented with cross-sectional drawings and cut aways. RANEY METHOD WATER SUPPLIES, INC.

NEW WAY TO

REDUCE STEAM COSTS

AND INCREASE PRODUCTION

☐ Here is a new steam trap that meets all operating conditions!

The Strong Hydro-Flex Steam Trap performs efficiently under light loads yet gives the same high standard of performance under heavy flow, also greater discharge capacity when needed.

We guarantee your steam system will improve with Hydro-Flex. Outstanding plus-features include: a dual fulcrum arrangement that snaps the valve wide open to give unrestricted condensate flow, all stainless steel working parts including one piece deep-drawn stainless steel bucket. The rugged construction features of Hydro-Flex provide long service life with minimum maintenance.

Your local Strong distributor will give you complete information or write us for Bulletin No. SS-40.

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STRONG HYDRO-FLEX STEAM TRAPS — high efficiency under all condensate loads

HORIZONTAL TYPE SERIES
Hydro-Flex traps with horizontal inlet have the same features as bottom inlet types.

Available from over 200 industrial distributors in the United States, Canada and Foreign Countries.

3 types available for wide range application . . . to meet pressure and capacity requirements.

PRESSURE REGULATING VALVES

are custom sized for job demands. Bolted body permits non-threaded seats and wide selection of seat sizes.

BLOW-DOWN VALVES

STRONG STRAINERS
Offer maximum protection from dirt, scale or sediment. Available in semi steel, cast steel and bronze.

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. . . . from industry & power

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Reprints of the following articles are available on single copy orders free of charge:

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- *Big Savings For A Small Plant*
- *Boiler Blowdown Control*
- *Bring Back Those Blowdown Btu's*
- *Bulk Handling as a Business*
- *Burners For Package Boilers*
- *Coal Burning Equipment Application and Selection*
- *Coal Dust . . . Stopped Before It Starts*
- *Combustion And Combustion Guides*
- *Electrically Heated Pipelines Keep Fuel Oil Flowing*
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- *How To Select Corrugated Expansion Joints*
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- *Spreader Stokers*
- *Synchronous Motors Do Two Jobs At One Time*
- *Television . . . The Eyes Of Industrial Control*
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- *When to Use Eddy Current Couplings for Speed Control and Clutching*
- *Which Should It Be . . . Electric or Pneumatic Controls?*
- *Will It Pay to Incinerate Your Waste?*
- *Why High Temperature Water?*

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of all articles appearing in INDUSTRY & POWER are always available in limited numbers.

Single copies of tearsheets can be had for the asking as long as supplies last. In addition, reprints are available of those articles listed on this page. Send requests, on your company letterhead, to Reader Service Department, INDUSTRY & POWER, Commercial Bank Building, St. Joseph, Michigan.

Special Report reprints

Individual copies of Special Report Reprints will be sent free upon request. Additional copies are priced as follows: 2 to 24 copies are 25¢ each; 25 to 49 copies are 20¢ each; 50 to 99 copies are 15¢ each; more than 99 copies are 10¢ each. Special Report Reprints available are:

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- *Annual Review and Forecast, 1955*
- *Combating Corrosion From Industrial Chemicals*
- *Contaminants in the Air*
- *Control Valves and Positioners*
- *Demineralization—A Means to Purer Water*
- *Industrial Waste Treatment*
- *In-plant Electrical Distribution*
- *The Packaged Boiler Picture*
- *A Thermodynamics Refresher (Parts I through IV)*

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and
Anhydrous Ammonia Plants
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complete Anhydrous Ammonia and L.P. Gas plants
designed - installed
H. Emerson Thomas & Associates, Inc.

Has that man gotten lazy? All he does is sit and watch the gauges.

The more he sits on his chair, the better I like it. It means the steam pressure is where it should be and everything is fine and dandy.

He used to be jumping around like a monkey on a hot stove.

That was before we got wise and changed our coal.

What kind of coal are we using now?

It's a high quality, low ash coal produced on the Chesapeake and Ohio. The C&O coal man recommended the exact grade best suited to our type of furnace. It burns hot and clean, with practically no smoke or clinkers and very few ashes. I've learned there's a lot more to buying coal than merely the price per million BTU's. It takes a competent combustion engineer to weigh all the factors and pick the coal that will give the most economical operation under a given set of conditions. Those C&O people really know their coals and I'm listening to their advice from now on.

P.S.

There's a lot more to buying coal than the cost per ton. For facts and figures to solve your particular fuel requirements, write to: R. C. Riedinger, General Coal Traffic Manager, Chesapeake & Ohio Railway Company, Terminal Tower, Cleveland 1, Ohio.

Chesapeake and Ohio Railway

WORLD'S LARGEST CARRIER OF BITUMINOUS COAL

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Quality Valves
FOR
TEST STANDS

10,000 psi Needle Valves
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Micrometer Adjustment Needle Valves
Pressure Snubbers
Adjustable Gage Protectors
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No Lubricant "Teflon" Plug Valves
6,000 psi Lo-Torq Selector Valves
pressure balanced for easy turning

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INSTANT SETTING FLOOR PATCH

Repair broken factory floors without the usual traffic tie-up. Simply shovel INSTANT-USE into hole or rut—tamp smooth—truck over! No Waiting! INSTANT-USE bonds tight to old concrete—right up to a feather edge. It's tough. Wears like iron. Won't crack or crumble. Install complete overlay where floors are badly chewed up. Used indoors or out. Immediate shipment.

MAIL COUPON for TRIAL OFFER and FREE BROCHURE

INSTANT-USE

FLEXROCK COMPANY (Offices in principal cities)
3605 Filbert St., Philadelphia 1, Pa.

Please send me complete INSTANT-USE information, details of TRIAL ORDER PLAN and Free INSTANT-USE BROCHURE — no obligation. (Clip and attach Coupon to Co. letterhead).

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Company .....
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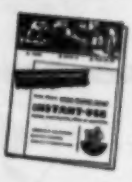

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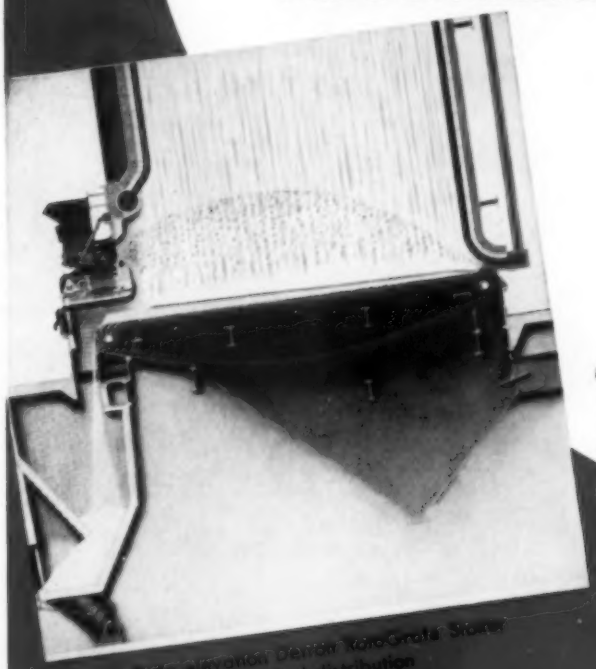
SOLVAY PROCESS DIVISION
Allied Chemical & Dye Corporation

USES DETROIT ROTOGRATE STOKERS

at Moundsville to Burn West Virginia Coal

Detroit RotoGrate is a modern spreader stoker with grates that move slowly forward, discharging ash at the front. It will burn any type of Bituminous coal or Lignite and many types of combustible refuse with high efficiency. Handles rapidly fluctuating loads. Produces more capacity per square foot of grate area. Precise control of fuel feed with grate speed and air supply provides smokeless operation.

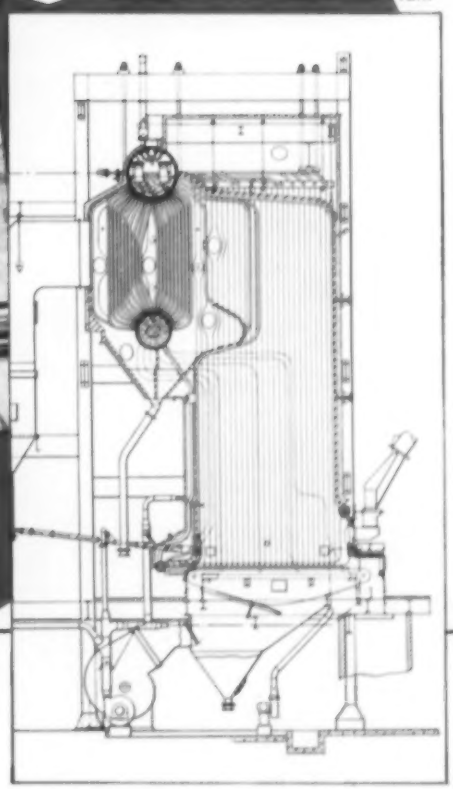
There is a size and type of Detroit Stoker for every industrial need.



Side elevation Detroit RotoGrate Stoker shows uniform fuel distribution and continuous cleaning feature.

Moundsville, West Virginia (Marshall County) Plant, Solvay Process Division, Allied Chemical & Dye Corporation.

Detroit RotoGrate Stokers with Babcock and Wilcox two drum Stirling boilers in Moundsville Plant



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GENERAL MOTORS BLDG. — DETROIT 2, MICH.
DISTRICT OFFICES IN PRINCIPAL CITIES • WORKS AT MONROE, MICH.

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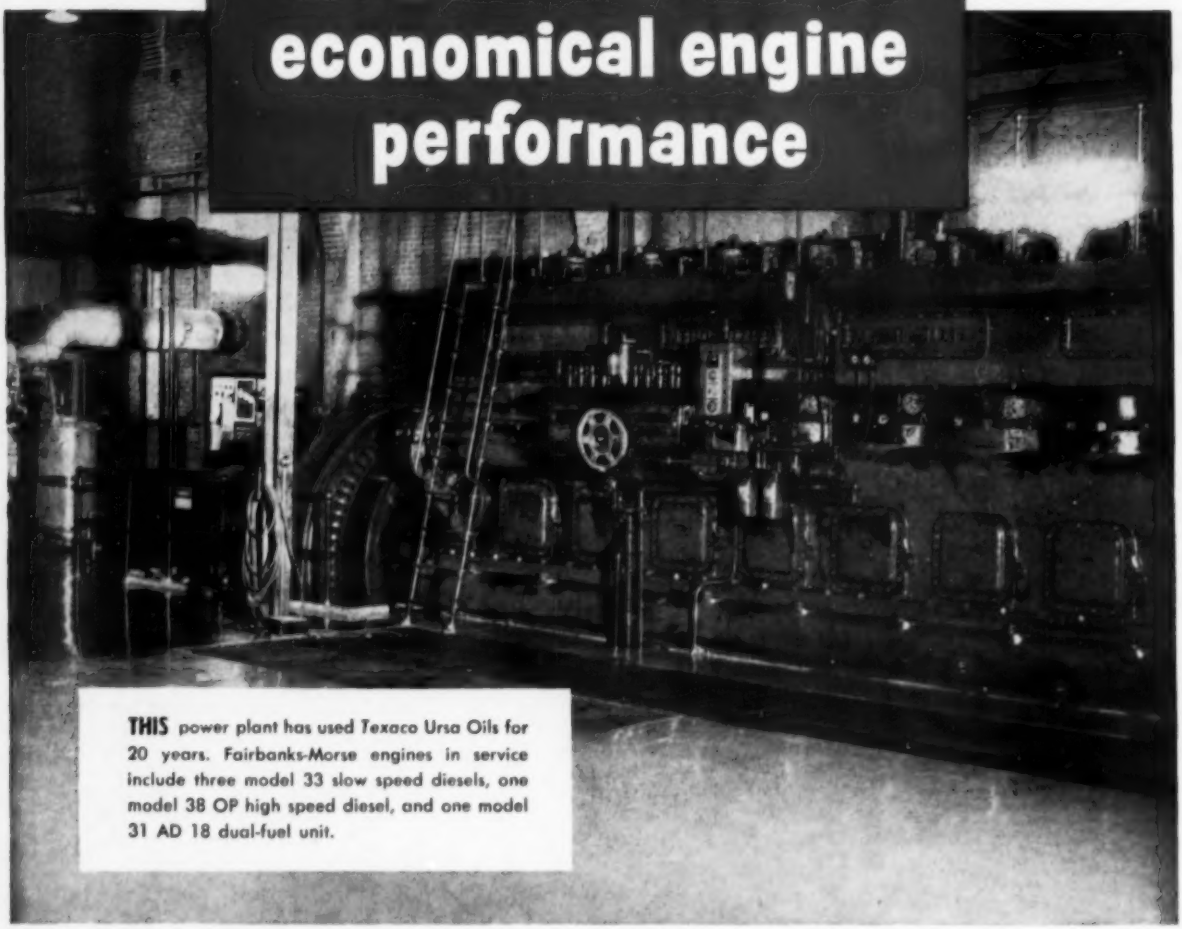
20 years of clean, economical engine performance



THIS power plant has used Texaco Ursa Oils for 20 years. Fairbanks-Morse engines in service include three model 33 slow speed diesels, one model 38 OP high speed diesel, and one model 31 AD 18 dual-fuel unit.

THIS plant (name on request) operates both straight diesel and dual-fuel engines – all of them lubricated with *Texaco Ursa Oil*. The Plant Superintendent says:

"Never, in more than 20 years, has Texaco Ursa Oil 'let us down.' Our engines stay clean, wear is negligible, and we enjoy real fuel economy."

This experience is typical. *Texaco Ursa Oil* does a great job of keeping engines clean. It stands up under heat and pressure . . . stands off oxidation and sludging . . . keeps rings free for proper compression and combustion. This means you'll use less fuel . . . spend less for maintenance.

There is a complete line of *Texaco Ursa Oils* to give your diesel, gas or dual-fuel engines the best "run" for your money. Leading engine builders O.K. them, operators everywhere use them. In fact–

For over 20 years, more stationary diesel h.p. in the U.S. has been lubricated with Texaco than with any other brand.

Get the full story from your Texaco Lubrication Engineer. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

☆ ☆ ☆

The Texas Company, 135 East 42nd Street, New York 17, New York.

TEXACO

TEXACO URSA OILS

FOR ALL DIESEL, GAS AND DUAL-FUEL ENGINES

TUNE IN . . . TEXACO STAR THEATER starring JIMMY DURANTE on television . . . Saturday nights, NBC.

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